Telephone Engineer

Do Your Small Exchanges "Pay Their Own Way"?

ONE of the fundamental rules of business practice is that every unit of an organization should "pay its own way." If any one department depends too much upon the others for support, not only is the progress of the whole enterprise hindered, but profitable operation may be made impossible.

In the telephone industry, it is most frequently the small exchange which constitutes the drag on the rest of the organization. Its existence has in many cases been profitless, but necessary.

The newly-developed types of Strowger Automatic small exchanges, however, change small exchanges from profit-losers into profit-makers. By converting them to Strowger operation, they not only become self-supporting, but, more than this, they provide a definite source of steady profit. The records of Strowger Automatic small exchanges, wherever they have been installed, definitely prove their profit-making possibilities which progressive telephone executives cannot afford to overlook.

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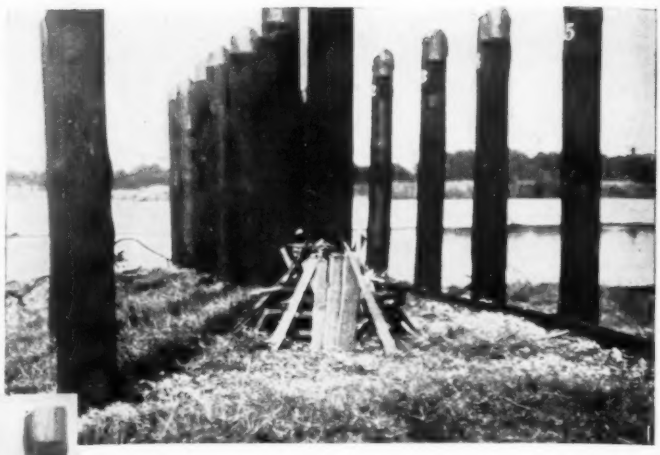
STROWGER AUTOMATIC

AUGUST, 1928

Creosoted Poles *reduce* losses from FIRE

Contrary to the belief of many uninformed, Creosoted Poles are more resistant to fire than untreated poles. Through the years the relative resistance of Creosoted Poles *increases*, while the resistance of untreated poles *decreases*---because decay attacks them, and decayed wood ignites and burns more readily than sound, undecayed wood.



THE pictures shown on this page tell a real story. No. 1 above shows an armful of pitch-pine kindling piled around the base of a section of a "Black Beauty" Creosoted Pine Pole. (Note that this is a far more severe test than poles are subjected to from ordinary grass fires.)

In the presence of a group of engineers and purchasing agents from organizations in widely scattered parts of the country, this kindling was lighted. Photograph No. 2 shows the kindling burning. It created quite a hot fire. The creosote oil in the pores of the pole directly exposed to the flames ignited and burned with a heavy black smoke. This prevented the amount of oxygen necessary for combustion from reaching the pole. In other words, *the fire smothered itself out.*

As you will note in picture No. 3, all of the kindling burned. The only effect on the "Black Beauty" Pole was to char it for a depth of less than ½ inch, for a distance of about eighteen inches above the ground. Otherwise it was unharmed; its strength little diminished and its ability to resist decay for generations not lessened at all.

Picture No. 4 at the bottom is mute testimony to the verity of the above test. Fire destroyed this entire block, in Baton Rouge, La., including a filling station. The heat was intense---yet the creosoted pine poles just a few feet away were only slightly damaged. It was found unnecessary to replace them.

Resistance to fire is but one of the many advantages that recommend "Black Beauty" Poles to those who are endeavoring to lower maintenance and upkeep costs through the years. They are one of the soundest investments that any company can make---paying for themselves over and over, in freedom from failures from any cause whatever, and preventing costly service interruptions and losses. Shipments can be made promptly from stock, in almost any size and quantity.

"Black Beauty" Poles can be identified by their red tops. Every pole that bears this trade-mark has been effectively treated.

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Perfected Strand

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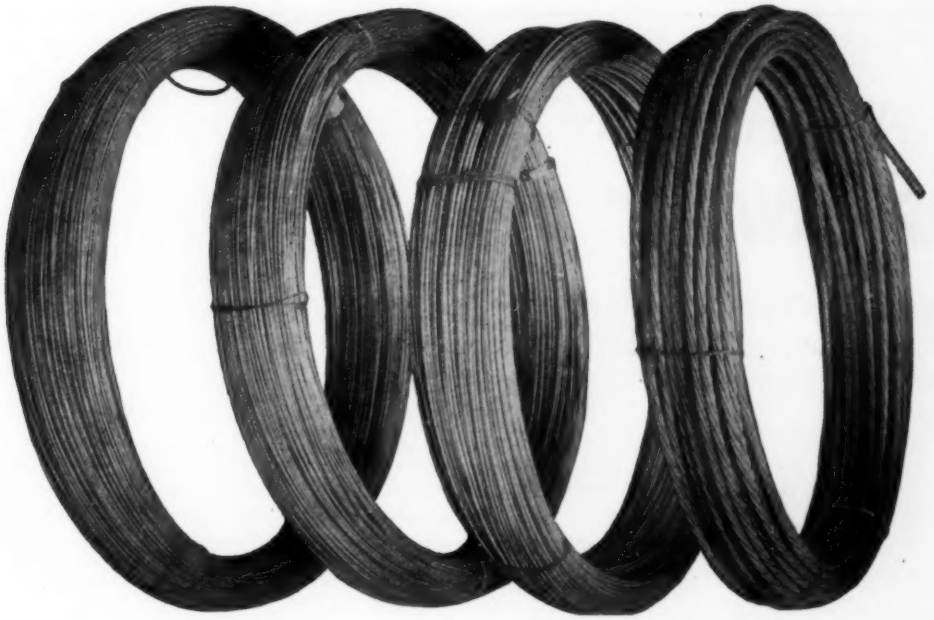

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*United States Steel Products Company

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Table of Contents

Editorial 15-16
It Pays to Be Human—Undigest Securities—Too High Rates a Detriment—Opportune Time to Increase Rates—Service Connection and Moving Charge.

Practical Suggestions for Plant Valuation—By Charles W. McKay 17-18-19-20

Studying Telephone Methods—By E. R. Collins 21-22-23-24

The Vacuum Tube and Its Applications—By F. J. Dommerque 25-28-29-30

Line & Desk 31

Electrical Policeman 32-33

Co-operation in the Telephone Industry—By G. M. Kloidy 34-36

A Unique Switchboard Installation—By H. N. Faris 38-40

Design of Small Central Office Buildings—By B. C. Burden 42-43-44

Index to Advertisers

American Cross Arm & Conduit Co. 41
American Electric Co., Inc. 2-10-26-27
American Steel & Wire Co. 9
American Telephone & Telegraph Co. 35
Automatic Electric Co. 1-51

Bell Lumber Co. 41
Bernz Co. 47
Blake Signal & Mfg. Co. 47
Bowdle Accounting System 47
Buckeye Telephone & Supply Co. 48

Carbon Products 12
Chance Company 40
Coffey System & Audit Co. 48
Contact Metals Co. 48
Cook Electric Co. 14
Copperweld Steel Co. 10
Earl L. Carter 48
Electric Storage Battery Co. 47
French Battery Co. ..... —
Ernest J. Mendel 48
Graybar Elec. Co. ..... —
Hayes Hotel 39
Herdrich & Boggs 48
Holtzer-Cabot Electric Co. 12
Hotel Cass 12
Hotel, Great Northern 46
Hubbard & Co. 35
Indiana Steel & Wire Co. 12
International Creo. & Con. Co. 52
Johnson, A. J., Elec. Co., Inc. 50
Johnson, J. K. 48
Kearney Corp., Jas. R. 13

Kellogg Switchboard & Supply Co. 4-5
Matthews Corp., W. N. 3
MacGillis & Gibbs 41
McKay, Chas. W. ..... —
Miller, Wm. M. 48
Minnesota Electric Co. 48
National Cable Compound Co. 47
National Carbon Co. 11
Naugle Pole & Tie 41
Northern White Cedar Ass'n 49
Premier Electric Co. 47
Prest-O-Lite Co., Inc. 39
Rebuilt Electric Equipment Co. 46
Reliable Electric Co. 8
Republic Cedar Co. 41
Snook, Martin & Co. 48
Signal Eng. & Mfg. Co. 12
Standard Underground Cable Co. 47
Stewart Bros. 47
Stromberg-Carlson Tel. Mfg. Co. 6-7
Suttle Equipment Co. 46
Telephone Repair Shop 46
T. M. Partridge Co. 41
Texas Creosoting Co. 2
Universal Specialty Co. 46
Unique Mfg. Co. 46
Wall, P., Mfg. Supply Co. 10
Welker, J. H. 48
Western Electric 37
Wm. H. Pearl 46
Wm. C. Meredith Co. 41
Wray & Co., J. G. 48
Williams, Geo. E. 47

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Copperweld wires "ride thru the storm." They stay up long after copper and (new) galvanized wires of equal and larger sizes are down. Size for size Copperweld is 75 per cent safer.

Copperweld wire cannot rust. The copper exterior is permanently molten welded to the steel core. It can never crack, split or peel. It combines the endurance of copper with the strength of steel.

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Distributor to the Independent Telephone Trade

Telephone Engineer

Volume 32 AUGUST, 1928 No. 8

It Pays to Be Human

It seems to us that the telephone business is gaining in personality at a rapid rate. A few years ago, who would have thought of writing into an instruction book for toll operators, the direction that the operator should address the subscriber as Mr. Blank whenever it seemed natural to do so. The operator was once a talking automaton rather than an intelligent, accommodating sales person anxious to be of maximum service to the customer.

In the plant and commercial departments similar changes are taking place. When trouble is reported, where the complaining subscriber was once dismissed by a curt "I'll report it," he now sometimes hears, "Will there be someone there for the next hour? I will have a repairman there to take care of it." The repairman himself has changed into a neat, courteous workman instead of a burly individual who shouts "telephone man," opens the door and tramps through the house to the telephone instrument.

The young man who takes an application for service now seems to hav· a real information as to what kind of service can be furnished and which is best suited to the needs of the subscriber. He has a real interest in seeing that the most suitable type is furnished. He is no longer a person who shoves out a blank contract and a pen, saying "Sign here. Pay the service connection charge at the third window."

Why and how has this change been coming about? The most probable answer in our judgment is that we are learning that, in the long run, when we are dealing with human beings it pays to be human.

"Undigested Securities"

We are beginning to see more and more that the present wave of speculative buying and selling of telephone property is not a thing peculiar to the telephone business but is merely another manifestation of the speculative fever that has been sweeping the nation in the last two years. At its beginning, many telephone men assumed that their business was the only one concerned, but it is apparent now that all business has been going through much the same process.

Financial pages of daily newspapers and other financial publications are filled with news of sales, purchases, recapitalizations, consolidations and a variety of other changes in corporation control. It has affected almost every industry and business in the country. Gas, water and electric utilities, coal mines, toilet preparation manufacturers, printers' ink manufacturers, department stores, automobile makers are only a few of the businesses involved. We have even seen the maker of a coffee substitute purchasing the business of the distributor of a widely advertised brand of coffee.

For a while it seemed that there was no bottom to the great American pocket bulging with funds available for investment and an enormous volume of securities of these promotions were sold to the investing public or dumped onto the speculative market. However, the end was reached and the market no longer absorbed the offerings and it is said that these "undigested securities" have been marketed, if they have been marketed at all, at very large discounts.

During recent weeks since the money market has tightened, the number of new issues has decreased, relieving the situation somewhat, but in some quarters, opinions are expressed that there will be little easing of the tension for several months.

Whether this will have a tendency to slow down changes in the telephone field is still to be determined. Prospective purchasers are still in the field looking for properties that may be bought and prices paid continue to be high; higher in some cases than conservative telephone men think safe. How much longer this will continue can not be foretold, but one thing is certain, the man who buys too late on a bull market is in danger of a severe headache when the market turns.

Too High Rates a Detriment

For a dozen years one of the problems of the telephone industry has been the securing of adequate rates in the small exchanges. Some communities were habituated to dollar-a-month telephone service just as some of the large cities were accustomed to five cent street car fare and the habit was difficult to break. It is not even yet entirely broken for there are many communities still trying to get telephone service at 1900 rates.

Low rates and insufficient revenue resulting therefrom are a handicap not only in the exchange where the rates are low, but to the neighboring exchange, where the management is trying to give good service at a living rate. As Mr. J. G. Crane pointed out in a recent paper, there are certain areas which are known "low rate" areas. Many telephone men have found out that it is extremely difficult to increase the rate in one exchange in some of these areas and so the problem becomes one not only for the individual exchange, but for the area itself.

With the grouping of large numbers of small exchanges under ownership and management with experience only in larger exchanges or with no experience at all, in our attempts to avoid the peril of too low rates we are likely to rush into the kindred peril of too high rates. We must not forget that insufficient revenue will associate itself with high rates as well as low rates.

When the rates in a small exchange are pushed up to the point where there are a number of subscribers who can not or will not retain the service, we have not only a reduction in potential revenue, but a reduction in value of the service to those who retain it. If they are pushed up still further still a larger number will not retain the service and there is still further reduction in value of service to those who remain subscribers.

Insufficient revenue is an evil in itself, but it is a greater evil when due to too high rates than when due to too low rates. Rate adjustments are necessary from time to time to correct cases of insufficient revenue, but when they become necessary, a careful study of the individual community as to its ability and willingness to pay, should be made in order to avoid the introduction of a rate schedule which may unduly restrict the development of the service.

Opportune Time to Increase Rates

Some one has pointed out that the best time to solicit for new subscribers or for higher grades of service is when work is being done on the plant. When a gang is at work reconstructing lines or otherwise improving the plant, interest in telephone matters in the neighborhood of the work is increased and the telephone becomes a matter of conversation. There are always a certain number of non-subscribers who are just on the verge of applying for service and at such a time their applications may easily be obtained by a visit of the telephone company representative.

A telephone manager recently told us of the securing of three new contracts while the work of rebuilding a five-mile section of rural line was being done. Two of these were brought in by the gang foreman and the third was obtained by a call from the manager. The history in each case was about the same. Information of the prospect was obtained from others on the line. This information was followed up by a call and the contract was secured.

One of the advantages of securing this business lies in the fact that when construction or reconstruction work is being done, spare facilities are provided based upon estimated ultimate needs of the area. If the new business can be obtained immediately, the investment in additional plant comes into earning at the earliest possible date. Thus a little effort spent in obtaining the business results in immediate return.

Service Connection and Moving Charge

In certain quarters there has been some discussion of the question of service connection and move charges. During the war a uniform schedule of charges was placed in effect by order of the Postmaster General. After the operation of telephone properties was returned to the companies, these charges were varied to some extent. In some states they were discontinued entirely while in others they were modified and in others the Postmaster General's schedule was continued.

On August 1st one of the Bell companies which has been collecting the charges according to the Postmaster General's schedule, announced reductions in the charges for certain classes of service, placing into effect a graduated scale instead of flat charges for all classes of service. The charges for installing residence extensions and for inside moves was reduced materially while other classes of service were reduced to a smaller extent or not at all. It is probable that this action will cause other companies to look into the question in order to determine their own policy.

We believe there is a sound reason for some kind of advance payment or service connection charge and for a charge for inside moves. Like many other things that are sound from a purely theoretical standpoint, there have been some difficulties in administration. There is also the practical question of the effect upon the development of business. However fair the charges may be, if they operate to retard growth, it is a question as whether in the long run it is to the best interest of the company that they be made. It is a question that each company may well study in the light of its own conditions to see if modification is advisable.

Practical Suggestions for Plant Valuation

By CHARLES W. McKAY, M. E.*

CHAPTER XIV.

In the July installment we began a discussion of the subject of Collateral Construction Costs. In this installment we will continue our treatment of this same phase of the subject of Valuing Telephone Properties.

Before proceeding, however, I wish to again lay emphasis upon the fact that the collateral costs are just as much a part of the total cost of the physical property as are the direct construction costs—i.e., the cost of poles, wire, cable, etc.

There are obvious reasons, however, why the collateral costs cannot be allocated directly to the unit cable costs, unit wire costs, unit pole costs, etc.

To illustrate, collateral costs include the following items:

General and legal expense during construction.

Engineering and general supervision during construction.

Taxes and insurance during construction.

Interest during construction.

Omissions and contingencies.

To clarify the point I am trying to make—take the item of interest. Imagine how difficult, and how foolish, it would be to try to compute the interest chargeable (during the construction period) to each classification of crossarms; to each size of pole; each size of wire, etc.

The very nature of this group of items precludes the possibility of incorporating allowances for them in the unit costs. They apply to the plant as a whole, and hence we must first determine the total of the direct construction costs, and then the proper provision for the group of items we are now discussing.

It is unfortunate that the collateral costs cannot be included in the unit costs. Their segregation sometimes creates the erroneous impression that they are something entirely apart from the direct construction cost—something that has been added for good measure.

Several cases might be cited where counsel representing municipalities or civic organizations in rate cases, either through ignorance of the subject in hand or through a willful attempt at misrepresentation, have tried to prove that the collateral costs—or "Overhead," as they are sometimes called—are not a real element of cost, but an imaginary value added for the sole purpose of padding the total value of the plant. Fortunately, most of the State commissions, and many of the courts, have had a wide and varied expience in appraisement problems, and are disposed to be absolutely fair in their allowance for collateral construction costs.

Before continuing the discussion of the Collateral Construction Costs, it may be said that there are various ways of grouping these items. Ordinarily, plant supervision and supply expense would not be included with the Collateral Costs—but rather with the Unit Costs. This, for the reason that it is a comparatively simple matter to allocate the amounts (at least in terms of percentages) which should be charged for the supervision in connection with poles; the supervision in connection with aerial wires, cables, underground conduits and cables, etc., etc. The same general remarks apply to the item supply expense. We know how much material is involved, and we can readily compute a proper allowance for purchasing and handling this material.

However, to conform with the wishes

The Blank Telephone Company Revised Final Summary of Accounts All Exchanges

Account Number	Description	Reproduction Cost	Cond. %	Present Value
207	Right of way	$ 15,058.97	....	$ 15,058.97
211	Land	31,200.00	....	31,200.00
212	Buildings	115,507.20	....	108,576.72
221	Central office equipment	267,584.49	....	240,826.04
222	Other equipment of C. O.	4,113.35	....	3,290.68
231	Station apparatus	115,629.20	....	101,940.51
232	Station installations	26,767.13	....	23,597.24
233	Private branch exchanges	7,837.74	....	7,402.36
235	Booths and special fittings	1,306.12	....	1,082.37
241	Exchange pole line	133,647.35	....	102,771.85
242	Exchange aerial cable	73,750.87	....	70,135.65
243	Exchange line wire	86,176.01	....	64,761.31
244	Exchange U. G. conduits	100,344.28	....	93,922.25
245	Exchange U. G. cable	95,220.15	....	92,649.21
251	Toll pole lines	8,114.75	....	6,116.42
253	Toll pole wire	4,712.11	....	2,542.30
261	Office furniture and fixtures	6,454.83	....	5,485.76
262	General shop equipment	1,156.50	....	925.20
264	General stable and garage	5,481.07	....	3,367.48
265	General tools and implements	2,856.91	....	2,142.68
	Total Inventoriable Property (exclusive of omissions and contingencies; plant supervision and supply expense)	$1,102,919.03	88.7	$ 977,795.00
	Omissions	10,566.59	....	.....
	Contingencies	22,058.38	....	.....
	Plant supervision and sup. expense	176,467.04	....	.....
	Total Inventoriable Property	$1,312,011.04	88.7	$1,163,753.79
268	Int. during const. @ 8 %			
271	Eng. during const. @ 4 ½%			
272	Legal exp. during const. @ 1 ½%			
273	Taxes during const. @ .66⅔%			
274	General const. exp. @ 2 %			
		16.66⅔% 218,667.63	88.7	193,958.19
	Total Physical Property	$1,530,678.67	88.7	$1,357,711.98
	Working Capital, including supplies	56,612.98	....	56,612.98
	Going value	229,601.80	....	229,601.80
	GRAND TOTALS	$1,816,893.45	....	$1,643,926.76

Fig. 1

*Consulting Telephone Engineer, 236 N. Clark St., Chicago, Ill.

of some commissions, plant supervision and supply expense are sometimes segregated from the unit costs and also segregated from the collateral costs. In other words, they are woven into the picture in such a way as to provide an intermediate item between the total inventoriable property and the collateral construction costs. Fig. 1 presents an illustration of a valuation summary set up in accordance with the foregoing stipulations.

We are now ready to take up a detailed consideration of the various component elements of collateral cost—from the point where we stopped in the July installment.

General and Legal Expense During Construction

Taking up the items of collateral cost in the order in which they would naturally occur, we have, first, the general and legal expense during construction. This item includes salaries of general executives—such as the chief executive, treasurer, auditor, etc., general office expenses and retainer for legal counsel. These should be estimated by the appraisal engineer from his general experience in similar cases.

Estimate of General and Legal Expense

An estimate of the general and legal expense incurred in the construction of a property designed to serve between 50,000 and 60,000 subscribers is presented which shows what is included under this heading. It was assumed that the construction of the plant would take about five years. The first six months of the construction period will be required for the preliminary negotiations, and the remaining four and one-half years for actual construction.

Office rent (2,000 square feet), 5 years at $1,000	$ 5,000
Salary, chief executive, 5 years at $10,000	50,000
Salary of auditor-treasurer, 5 years at $4,000	20,000
Retainer for legal counsel, 5 years at $6,000	30,000
Cashier paymaster, 4½ years at $2,000	9,000
Bookkeeper, 5 years at $1,500	7,500
Average of ten clerks and stenographers, 5 years at $900 each	45,000
Office expenses, supplies, stationery, telephone, telegraph, etc., 5 years at $1,500	7,500
Total general and legal expense during construction	$174,000

Engineering and General Supervision During Construction

The cost of engineering is usually estimated as a percentage of the cost of the inventoriable property. The allowance ranges from 3 to 6 per cent, depending mainly upon the size of the plant. In very small installations one man may handle both engineering and general supervision. In cases of this kind an allowance of 5 or 6 per cent is usually sufficient to care for both of these items.

In the construction of large plants a separate organization is required for the general supervision. The unit costs include only the cost of direct supervision—that of the gang foremen in charge of the various jobs.

All supervision between the gang foremen and the executive staff is cared for under the heading, "general supervision," not only the salaries of the general superintendent, general foremen and their assistants, but all of the miscellaneous expenditures incidental to their work which may be incurred in the construction of a large utility property.

Illustration of Cost of General Supervision

The estimate which follows, of the cost of general supervision, is for the plant referred to under general and legal expense, serving between 50,000 and 60,000 subscribers.

The construction period is assumed to extend over five years, the first six months of which will be largely devoted to preparatory work. It will, however, be necessary to have the general superintendent, his chief clerk and certain others of the supervisory staff on hand throughout the entire period, as indicated in the following schedule:

Salary of general superintendent of construction, 5 years at $4,000	$ 20,000
Salary of chief clerk, 5 years at $1,800	9,000
Salary of chief stenographer, 5 years at $1,000	5,000
Additional stenographers, an average of 3 for 4 years at $600 each (these stenographers will be required for typing orders and attending to routine correspondence)	7,200
Pay-roll clerk, 4½ years at $900	4,050
File clerk, 4½ years at $600	2,700
General foreman of aerial construction, 4½ years at $2,100	9,450
General foreman of underground construction, 4½ years at $2,100	9,450
General foreman of cable installation, 4 years at $2,100	8,400
General foreman of cable splicing, 4 years at $2,100	8,400
General foreman of equipment, 4 years at $2,400	9,600
Assistant foreman of equipment (in charge of station installation), 3 years at $2,100	6,300
Rent of office space (1,500 square feet), 5 years at 60 cents a square foot per annum	4,500
Office supplies, stationery, telephone and telegraph, car fare, automobile usage, etc	14,950
Total general supervision during construction	$119,000

Computation of Taxes, Insurance and Interest During Construction

Both taxes and insurance during the construction period form a very real part of the total cost of building a utility property. However, in computing these elements of cost there is one point which must be clearly borne in mind: as soon as any portion of the plant is put into actual service, both taxes and insurance for that portion cease to be a construction expense. They must be cared for in exactly the same way that they would be in the case of any regularly operating plant, as a deduction from gross earnings. The same thing may be said of interest during construction.

In computing these three items—taxes, interest and insurance—it is necessary to first approximate as closely as possible the construction schedule that would probably be followed in the building of the plant, and then to determine the momentary equivalent, in terms of reproduction cost, of the plant constructed, or in process of construction, and of the plant in service, during each subdivision of the construction period.

These subdivisions are usually taken as of six months' duration (in the case of a small plant, a three months' period may prove more suitable). A five-year construction period would therefore be subdivided into ten periods of six months each, and the exact status of construction in progress ascertained for each of these subperiods.

The Construction Schedule

The determination of the schedule of construction expenditure is not as difficult a problem as it may at first appear. The appraisal engineer, from his familiarity with the conditions actually existing during the construction of other similar plants, can make a pretty accurate guess at the probable progress of construction in the case in hand.

During the first six months little or no construction work will be undertaken in the building of a telephone plant large enough to require five years for completion. During the second six months pole work will be actually undertaken, and in the third and fourth periods carried on at a rapid rate.

As soon as a reasonable number of poles have been erected wire and aerial cable crews will start work. Subway work should be started early in the construction period so as to insure its completion long enough before that of the aerial plant to enable underground cable crews to finish their work on schedule time.

In a multi-office exchange, work on the

main office—the office in the city's commercial center—will, of course, be expedited as much as possible so as to give the company a foothold in the community at the earliest possible moment. Work of installing subscribers' stations and drop wire will not be started until rather late in the construction period. It will probably overlap well into the period of actual operation.

With these points in mind, the appraisal engineer can lay out a plausible construction schedule, and decide what proportion of the total of each type of plant (poles, cable, wire, etc.) will be installed during each of the six months' periods. He can estimate the corresponding proportion of the total reproduction cost that will be expended during each period, and the proportion of the total contemplated plant put into service during each period.

	Reproduct'n Cost of Plant During Const.	Reproduct'n Cost to Date	Reproduct'n Cost of Plant in Service	Amount for Taxes	Taxes for Period	Taxes to Date
First Year—						
First half.....	$ 101,808	$ 101,808	.....	$ 101,808	$ 527	$ 527
Second half...	653,323	755,131	.....	755,131	3,912	4,439
Second Year—						
First half.....	700,336	1,455,467	.....	1,455,467	7,539	11,978
Second half...	960,321	2,415,788	.....	2,415,788	12,514	24,492
Third Year—						
First half.....	1,076,143	3,491,931	.....	3,491,931	18,088	42,580
Second half...	988,101	4,480,032	.....	4,480,032	23,207	65,787
Fourth Year—						
First half.....	1,033,927	5,513,959	4,390,253	1,123,706	5,821	71,608
Second half...	808,367	6,322,326	5,399,113	923,213	4,782	76,390
Fifth Year—						
First half.....	594,379	6,916,705	6,111,573	805,132	4,171	80,561
Second half...	627,648	7,544,353	6,789,686	754,667	3,909	84,470
Total Taxes During Construction.....						$84,470

Fig. 2—Illustration of the Computation of Taxes During Construction.

Computation of Taxes During the Construction Period

In computing the taxes, the prevalent tax rates for each type of plant should be ascertained from an examination of the company's tax statement for the several years preceding the appraisal, and also the ratio of assesses to book values. The taxe rates so determined will be applied to the reproduction cost of the taxable property during each six months' period.

The reproduction cost of the taxable property for each period will, of course, be the total reproduction cost of plant installed to date—including that placed during the period under consideration—less the reproduction cost of the plant already giving service at that date.

The rate to be applied for each six months' period will be half of the annual rate, or, more properly, taxes may be computed for the entire year, using the full cost, and pro-rated over the six months' periods. As an illustration, the tax rate for a certain property was found, from an examination of past records, to be $3.03 for every $100 of plant value. It was further found that for the several years preceding the appraisal the assessed value of the property was only 34.2 per cent of the book value.

The actual tax rate applicable to the reproduction cost is, then, 34.2 per cent of $3.03 or $1.036 per $100 of reproduction cost. The computation of taxes is given in Fig. 2.

Details of Tax Computations

That the method of derivation of the taxes as part of the reproduction cost may be clearly understood, the computations for one period—the first half of the fourth year—are given in detail:

Reproduction cost of plant installed during period.....$1,033,927

Reproduction cost of plant previously installed 4,480,032

Total reproduction cost of plant installed to date.....$5,513,959

Reproduction cost of plant giving service at date..... 4,390,253

Amount on which taxes are to be based, $5,513,950, less $4,390,253, or..... 1,123,706

Tax rate for six months' period equals:

$$\frac{\text{Annual rate}}{2} = \frac{\$1.036}{2} = \$0.518 \text{ per each } \$100 \text{ of valuation.}$$

$$\text{Taxes for period} = \frac{\$1,123,706}{100} \times 0.518 = \$5.821.$$

In the case under consideration the state taxed public utilities only on non-operating property and real estate. However, in many states utility corporations are subject to other taxes, such as taxes on franchises and capital stock.

Computation of Taxes Direct From Cost of Inventoriable Property

Taxes are sometimes computed directly from the cost of the inventoriable property without assuming a construction schedule. In the opinion disapproving the plant of reorganizing the Third Avenue Railway Company, dated July 29, 1910, the Public Service Commission of New York, first district, ruled as follows:

Mr. Floy estimates taxes at one-half of 1 per cent. This amount includes, apparently, every kind of tax from capital stock tax to franchise tax. It does not seem to be unreasonable and, except so far as it includes taxes in connection with the corporate organization of the old company, it should be allowed.

The former method, however, seems the more logical, and is much more likely to meet with favor in the eyes of courts and commissions in general.

Insurance Expense During Construction

There are three sources of insurance expense ordinarily encountered during the construction of a telephone property: Fire insurance—buildings, central office equipment, furniture and fixtures, tools and that portion of the construction material carried in the storeroom during each of the construction periods; employers' liability insurance; and insurance against injuries to the general public.

Insurance, like taxes, should be estimated on a periodic basis—the periods are usually assumed to be six months each—and the reproduction cost of plant installed less the reproduction cost of plant in service ascertained for each period and used as a basis for computing the cost of insurance.

Estimation of Fire Insurance Expense

In estimating fire insurance prevalent rates for similar risks, and rates paid for the several years preceding the appraisal on the property under consideration should be reviewed in determining a fair insurance rate for appraisal purposes. It should also be remembered that insurance rates are rarely applied to the full value of the property insured.

An examination of the company's insurance records for the several years preceding the appraisal should give the ratio of insured value to book value. This ratio may be applied to the reproduction-cost of the insurable property to get proper insurance base.

Liability Insurance in the Actual Construction Work

Liability insurance in actual construction work is based upon the pay roll of the construction forces. Hence, in computing the cost of "liability insurance during construction," we have, first, to determine the proportion of the total reproduction cost involving labor items only, and then to apportion this amount over the construction period.

A review of the unit costs for the

various types of plant will render possible a reasonably accurate estimate of the ratio of labor costs to total costs. This ratio applied to the construction schedule will give a proper base for use in determining liability insurance during each period.

The illustration which follows is taken from a recent appraisal of a telephone property. It will be noted that liability insurance was not allowed on subscriber's station installations, as there is practically no danger of injuring life or property in installing a telephone on private property; for that matter, there is very little danger of injury to the installer himself. But the additional cost involved is comparatively small, and most companies feel that it is better to be on the safe side in the matter of employes' insurance.

Example of Computation of Liability Insurance

An illustration of the method used in computing liability insurance is given in Fig. 3. In this table liability insurance was calculated on the basis of the working force involved in the construction of the plant, exclusive of general supervision. The rate for outside employes is $5.25 per $100 of pay roll. The rate for the general public is 22.04 per $100 of pay roll. The cost of liability insurance for employes and general public (Fig. 3) was estimated on this basis.

Period	Outside Employees	Substation Installers	Insurance Cost
First Year—			
Second half	$ 38,874	.....	$ 2,834
Second Year—			
First half	110,093	.....	8,026
Second half	144,602	.....	10,541
Third Year—			
First half	157,180	.....	11,458
Second half	150,667	$47,259	13,465
Fourth Year—			
First half	172,378	41,806	14,761
Second half	142,178	26,856	11,775
Fifth Year—			
First half	102,947	31,408	9,154
Second half	100,178	19,128	8,307
Total Liability Insurance During Construction			$90,321

Fig. 3—The Method Used in Computation of Liability Insurance.

Liability insurance is sometimes estimated on a flat basis, as a percentage of the labor cost of the insurable items. On this basis an allowance of three-fourths of 1 per cent of the estimated labor cost for employes' insurance, and three-fourths of 1 per cent for public insurance, or a total of 1½ per cent for liability insurance, is not an unusual allowance.

Interest During Construction

Courts and commissions are generally agreed that the interest on the capital used in constructing a utility property is an allowable element of the total reproduction cost during the period that the capital is lying idle. As soon, however, as any portion of the plant is put into active service, interest on the capital invested in that portion of the plant ceases to be an element of cost, and becomes a part of the company's operating expenses.

In the case of Pioneer Telephone & Telegraph Co. v. Westhaven (118 Pac. 354) the Supreme Court of Oklahoma rendered the following opinion:

The commission refused to allow it (interest during construction) because it did not consider it a proper element of reproductive value. Counsel for the commission, however, at the oral argument before this court conceded, and we think properly that there is no ground for refusing its allowance; . . . no case has been cited, and in our investigation we found no case involving this question, where a reasonable amount has not been considered and allowed for loss of interest during construction as part of the cost of construction.

The Rate of Interest

The amount allowable for interest during construction will, of course, depend upon the rate at which interest is computed, and upon the length of time during which the accrued interest is considered a capital rather than an operating expenditure. Rate of interest will be governed by the prevalent cost of money in the locality of the property under consideration, and by the general attitude of the courts and commissions having jurisdiction over the territory involved, as evidenced by their decisions in similar cases in the past.

There is one point in this connection which should be clearly borne in mind; it sometimes happens that capital, held in readiness for use in actual construction, temporarily earns an increment during the period of inaction. As an illustration, the promoters of a property may deem it advisable to borrow in advance sufficient funds to finance several years' construction. Such action may be warranted because of anticipated future tightness in the money market, expected advance in rates, or other pertinent reasons.

Until the money was actually required it would probably be deposited in a business bank or with a trust company, and there earn interest at a somewhat less rate than that charged by the original lenders.

In cases of this kind only the net rate should be used in computing interest during construction. If the money costs 6 per cent and earns 3 per cent, the difference, 3 per cent, should be used in determining the interest on the portion of the total capital earning a temporary partial return.

Computation of Interest During Construction

The proper length of time during which interest may be considered as a charge against the capital account should be readily determinable from the assumed schedule of progress of construction. Interest should be computed on the total of the direct construction cost plus those elements of collateral construction cost which we have already considered; i. e., general and legal expense, engineering and general supervision, taxes and insurance.

Taxes and insurance for the various six months' periods can, of course, be readily obtained from the detailed computations. Engineering, legal expenses, etc., will have to be pro-rated over the entire construction period, using the ratio of the other direct and collateral costs for each six months' period to their total cost, or distributed in accordance with the best judgment of the appraisal engineer.

In the September installment, the subject of collateral construction costs will be concluded, and a brief discussion will be accorded to the subject of working capital.

Anncunce Time and Place for 1929 Utilities Meet

Oklahoma City, Okla., was chosen as the place, and March 12-13-14 as the dates for the 1929 state convention of the Oklahoma Utilities Association, by the executive board of the association at its quarterly meeting here July 18. This will be the eleventh annual convention of this organization. Attendance is expected to be about 1,000, the registration including representatives of the electric, gas, telephone, and electric railway companies of the state, and of manufacturing companies supplying machinery and appliances related to the utility industry. L. W. Scherer of Yale is the president of the association.

Fargo.—Northwestern Bell Tel. Co. will install telephone at Hector Airport.

Minot.—International Airways, Inc., formed to establish and operate air-lines in North Dakota and for Northwest.

Studying Telephone Methods

By E. R. COLLINS

Manitoba Telephone System, Brandon, Manitoba

CHAPTER IX

Transmitters

The telephone transmitter may be a very simple instrument, but it is a very important one. Poor transmitters give poor voice transmission. There are three distinct types of transmitters, each of which, however, depend on the vibrating diaphragm to reproduce speech.

The telephone receiver with its permanent magnet, coils and diaphragm, can be used for a transmitter. The vibrating of the armature in front of the pole pieces, causes a magnetic field variation. This variation in turn appears in the induced currents in the receiver coils. This makes an excellent transmitter but it has one serious fault, in that the amount of electrical energy involved is so small as to be of little use in the transmitting of the voice over any distance. This can be overcome by passing the generated current through a one or two stage amplifier. This of course is prohibitive for use in commercial telephone service.

The capacity transmitter is another instrument that is a faithful reproducer of speech, but it has the same fault as the magnetic type mentioned in the previous paragraph. The output of the capacity condenser can be handled in the same way. In fact it is now being largely used in radio transmission work. A special amplifier is used to build up the strength of the voice current generated.

The capacity condenser simply consists of two condenser plates, the one plate being held rigid, both at the edges and the center so that it will not vibrate, and the other free to vibrate in the center, as the diaphragm of an ordinary transmitter vibrates. In our study of condensers, we learned that the charge capacity of a condenser depended on the size of the plates, but also on the distance apart. So if we vary the distance between the two condenser plates, we will vary the amount of charge they will hold. In the capacity condenser this is what takes place. The sound waves cause the diaphragm to vibrate, thus changing its distance from the stationary plate. Now if battery is connected through proper coils, to such a condenser, there will be no continuous flow of current, since the battery will not flow through the condenser. But there will be a charge impressed on the condenser plates by the battery. If this charge varies, it will cause a varying condition in the field of the induction coil connected in series with the battery. This will be transferred to the secondary of the induction coil in the form of alternating fluctuating current. This then can be built up through an amplifier to the desired strength. However, for commercial telephone work this type of transmitter is too expensive.

The carbon type of transmitter we discussed in a previous chapter. In brief, its operation is due to the fact that the carbon used to make the button, as it is commonly called, while a good conductor of electricity, is good only under heavy pressure of the carbon particles, and poor under light pressure. The one carbon button is held rigid, and the other carbon button is attached to the diaphragm. The space between the two buttons is filled about two-thirds full of carbon granules. The two surfaces of the buttons, facing each other, are highly polished. The carbon granules are also highly polished. It is very important that this be so. Unpolished carbon is composed of very small loose particles of carbon. If you rub your finger over the rough surface of a rack carbon you will rub off some of these small pieces, and your finger will be black. If two such surfaces were brought together, and a battery be connected to the two blocks, there would be a series of small arcs formed between the two carbons, where the loose particles are burning. If a receiver is connected in series with the battery there would be a loud roaring noise due to these small hot spots. This same thing will take place in a carbon transmitter if the carbon is too soft, or poorly polished. Therefore the grade of carbon used is very important.

The normal pressure between the two buttons is also very important. This pressure is set in the factory, and should not be altered. If, however, the lock nut or set screw that holds the back button in place should become loose, before resetting it, loosen up the pressure of the center damping spring against the diaphragm so that the diaphragm will straighten out. When in this position, lock the back button again, and reset the damping spring. It is best not to touch this part of the mechanism if you have no means of checking the transmitter for its normal position. Too much pressure will lower the resistance too much, and there will be too high a flow of current. This will have three bad effects. The button is liable to become too hot and some of the smaller granules will burn. Then if this should take place, there will be an excessive drain on the battery supplying the transmitter. Again the diaphragm will not be able to vibrate freely, and the result will be a transmitter that does not talk up good.

Current Flow of Transmitters

Transmitters will vary in resistance, according to manufacture. Measurement of several makes of transmitters showed a range of from 50 to 250 ohms. The ordinary run of transmitters will be between 50 and 70 ohms. Where high resistance transmitters are used they should be used in connection with special induction coil and battery arrangements. The output of an induction coil secondary depends roughly on the number of turns in the primary, times the amount of current flowing. If a transmitter circuit is designed to operate with two dry cells, through a 50 ohm transmitter, then the current times turns of the induction coil will be much greater than the same circuit with a 250 ohm transmitter. It is therefore quite important to use only the equipment that is designed to work best together.

The amount of current that flows in a transmitter circuit will be less than an ampere. Therefore we need a meter that will read in fractions of an ampere. Such a meter is called a milliameter. This meter will read in thousandth parts of an ampere. Each part is called a milliampere. This word is derived from the Latin word milli, meaning a thousand. The word milliampere then means a thousandth part of an ampere. The word is often abbreviated and spoken of as mill *amp.* or *mills.*

The following test was made with a Stromberg-Carlson magneto wall telephone. The millameter was connected in series with the battery and transmitter circuit, and the receiver lifted off the hook. The telephone was equipped with two dry cells. At the first reading when the receiver was removed, there was a current flow of 15 mills. At the end of five minutes another reading was taken with the current still flowing, and the flow had increased to 25 mills. The current was allowed to continue flowing and at 10 minutes read 70 mills, and at the end of 15 minutes read 150 mills. Readings taken at further intervals showed no increase in current flow. The increase in current flow was due to the heating of the carbon particles in the transmitter, lowering the resistance of the carbon. The hardness of the carbon and the resistance of the induction coil prevented any further increase in current flow.

After the transmitter was warmed up, different letters of the alphabet were spoken. A low bass voice speaking "Oh"

dropped the current flow from 150 mills to 55 mills, while the letter "e" spoken by a young lady made very little change in the 150 mill current flow.

Where two dry cells are specified by the manufacturer to be used with a telephone, they should be used and not three. But if the manufacturer specifies three cells, it is best to use three cells, as the transmitter and induction coil are designed to operate on a certain current flow to give the best results.

Operators' Battery Supply

The battery supply for operators' transmitters on the central office switchboard is one that is quite important. Nothing is more irritating to a subscriber than trying to make out what the operator is saying when the batteries are in poor condition. The gravity type of battery which give a voltage of a little over 1 volt, 1.07 volts per cell to be exact, requires 4 cells to operate the operators' equipment satisfactorily. This type of battery is ideal for this purpose, as it will deliver enough current for one operators' set, continuously until the cell is inoperative. Where this type of battery is used, it is best to equip the operators' circuit, so that if the transmitter is disconnected by pulling a plug out of a pack, the jack will connect a 50 ohm resistance in place of the transmitter. The gravity battery will remain in better condition if the circuit is closed continuously.

Dry Cell Operation

Where dry cells are used for the transmitter circuit, the reverse condition must be provided. The battery must just be connected to the transmitter when required for service. To do this modern keys have the extra battery springs provided to cut the battery dead when the key is normal. Three dry cells at 1½ volts each will be best to use on the average magneto board. Occasionally dry cells are connected in two or more banks, commonly known as series parallel. The idea is that the drain of, say, 100 mills for the transmitter will be evenly divided between the two banks of cells, 50 mills to each bank where two banks are used. This is all right, but occasionally you will find that such an arrangement results in shorter life for the battery than is the case where only one set of cells are used.

In Fig. 171 we have shown two sets of two cells in series. The carbon or positive posts of the two banks are connected, and the two negative or zinc posts are connected. The voltage of a battery will drop much quicker under a heavy load than a light one. So if we divide the load of 100 milliamperes between the two banks there would be only a drain of 50 milliamperes from each bank, therefore the voltage of each bank would remain higher, and result in better transmission.

Now suppose we remove the jumper wire (X) and connect a millimeter across from cell No. 2 to cell No. 4, and disconnect the transmitter. We would expect that there would be no current flow from 2 to 4. But suppose cell No. 1 is only 1.3 volts, and the other three are each 1.5 volts. Then bank of cells 1 and 2 would have a total voltage of 2.8 volts, while cells 3 and 4 would have a total of 3 volts. There would then be a difference of 2/10 of a volt between the two banks. Therefore the 3 volt bank would overcome the resistance of the 2.8 volt bank, and there would be a current flow around the 4 cells. Tests on several banks showed that in almost every case there was a small current flow, and in one set this flow was 27 milliamperes. If this action continues for any length of time, the battery will soon be of no use. A voltmeter such as the Weston model 45 range 2.8 volts will show up any difference in voltage between cells, and should be used to pick out cells of a uniform voltage if the series parallel scheme is to be used.

A better plan would be to use two separate banks of batteries, with a switch to change from one to the other, say every day. This would allow the cells to recuperate.

Storage Battery Operation

A 6-volt storage battery makes a very good current supply for the operator's circuit. If a 6-volt battery was used on a circuit designed to operate from two dry cells, the transmitter would get quite warm, and even quite hot unless some resistance were cut in series with the circuits. Suppose the 6-volt battery were connected to the circuit mentioned in the previous test. At the end of the 15 minute period, with 150 mills flowing through the transmitter, the resistance would be about 20 ohms, and this resistance would allow 300 mills to pass with the 6-volt battery connected. This would be double the amount intended to flow. To maintain a flow of 150 mills at 6 volts, a resistance of about 40 ohms should be connected in series with the transmitter circuit. Where only one operator's circuit is supplied from the one battery, the resistance can be a lamp, or a flat non-inductive resistance.

Where more than one operator's set is connected to one battery, then the resistance used must be in the form of a choke coil. The voltage variations set up by the transmitter would cause small voltage fluctuations in the battery, and these in turn would spread to the other operators' sets connected.

Fig. 172 gives the circuit arrangement required where the resistance coil is in the form of a choke coil. The induction coil requires a free fluctuation of the battery current due to the transmitter changes. But since this battery must flow through the choke coil, the iron of the choke coil will oppose the rapid changes set up by the transmitter. Therefore the induction coil primary will not receive the voltage changes required as they are damped by the choke coil. So the transmitter circuit would sound dead, and the operator would find it hard to make any one hear her. Now if we connect a M. F. condenser across from the transmitter to the battery as shown in Fig. 172, we provide a low reistance path for fluctuating current. Therefore the counter currents set up in the induction coil primary find an easy path through the condenser, and their effect on the secondary of the induction coil is increased. The double arrows in Fig. 172 show the path of the fluctu-

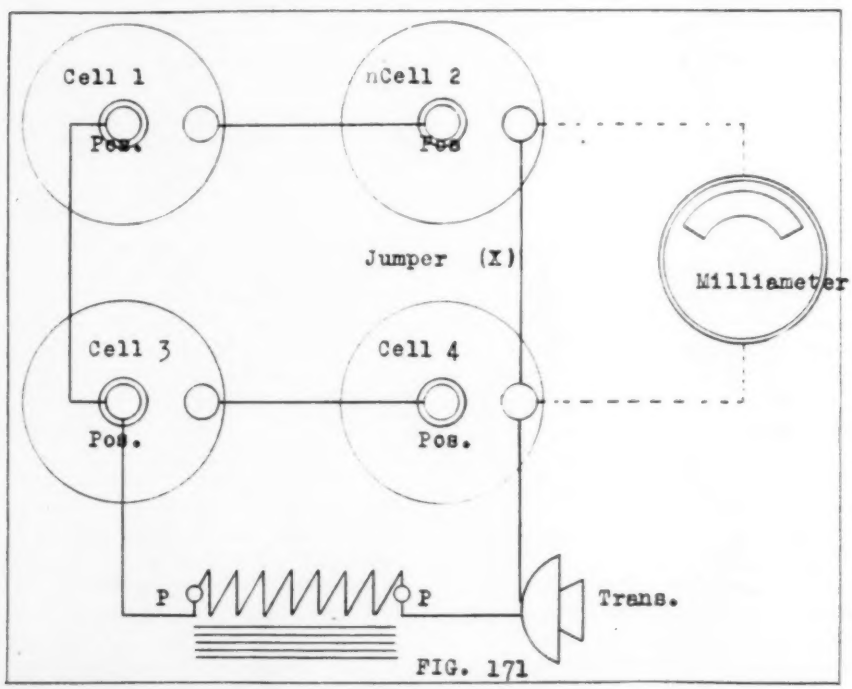


FIG. 171

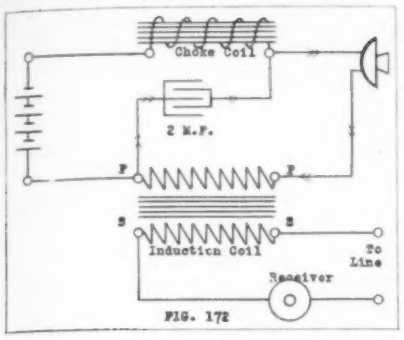


FIG. 172

ating currents set up by the primary of the induction coil. It will be noticed that they do not enter the battery at all. Thus we have accomplished two things. We have increased the efficiency of the induction coil, and also keep the battery practically free from any voice currents. In this way we can use several operators' circuits from one battery by the use of suitable choke coils. The following table gives the approximate direct current resistance of choke coils required to be used with different voltage of storage battery systems. In some offices, farm lighting plants provide the lights for the exchange. The same current supply can be used to operate the operators' sets. with the use of the proper choke coil and the condenser.

Voltage of battery.	D. C. resistance of choke coil.
6 volts	40 ohms
12 volts	80 ohms
24 volts	185 ohms
32 volts	260 ohms
48 volts	400 ohms

In ordering coils to use on battery systems, specify the voltage of operating current, and the manufacturer will supply the proper coil.

Side Tone

In Fig. 172, it will be noticed that the receiver is in series with the line and the secondary of the induction coil. If a short circuit was connected across the two line terminals, there would be a heavy load placed across the secondary of the induction coil or transformer. The greater the load of the secondary, the less the impedance of the primary. So the short circuit would lower the primary resistance to the transmitter changes, and the operator would hear the sounds from her transmitter very loud. This is commonly known as side tone. Where several operators are working in one room, the side tone makes it hard for an operator to hear what is being said to her by the subscriber. Circuit arrangements to overcome this are known as anti side tone circuits. The development of such a circuit is very interesting and will be found in other circuit arrangements which we will ecounter as we progress in our study.

In Fig. 173 we have four equal resistances of 100 ohms each. An alternating current supply is connected across 1 and 4 and a telephone receiver across the junction of 2-3 and 6-7. If the resistances are equal in every respect, the current will divide at 1 and 5 and flow down through the coils and back at 4 and 8. Suppose coil (B) is only 50 ohms. Then more current will flow down the 50 ohm coil (B) than through the 100 ohm coil (A). But the current which passed through the 50 ohm coil cannot find a path through the 100 ohm coil (D), and part of it will pass across the receiver to find its way through (C). Thus there will be quite a loud tone heard in the receiver.

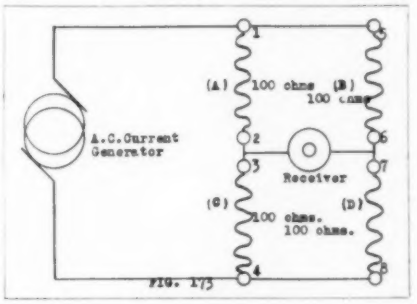


FIG. 173

In Fig. 174 we have included the primary of an induction coil on the same core as coils (A) and (C). Now if coils B and D are equal, and coils (B) and (D) are also equal, there will be no transfer of energy through the Receiver. However, if Coil (B) be reduced to 50 ohms then there will be a tone heard in the receiver. The greater the inequality the greater the tone heard in the receiver.

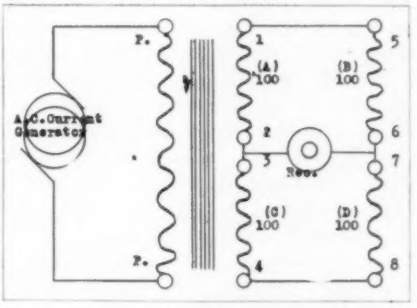


FIG. 174

Now if we remove the Coil (b) and connect a telephone line in its place across 5 and 6, we have a similar arrangement to Fig. 174. If the resistance of the telephone and line are equal to the resistance of Coil (D) current induced in the secondary coils (A) and (C) will flow through the telephone and Coil (D). There will be some slight difference due to capacity and other differences in resistance, which will make the line unequal to Coil "D." On this account there will be a slight transfer of energy through the receiver.

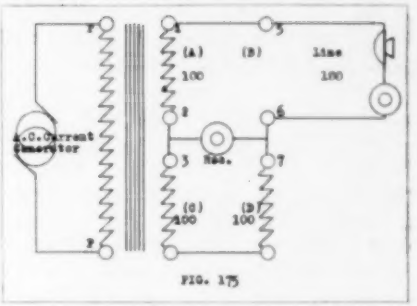


FIG. 175

In Fig. 176 we have replaced the alternating current supply with a transmitter and battery. Then sounds spoken into the Transmitter will induce currents in the secondary coils (A) and (C) which will flow out over the line and through coil (D). Due to the slight difference between the line and coil (D) there will be some of the voice current flow through the receiver. But practically the full voltage induced in coils "A" and "C" will pass through the receiver of the telephone connected to the line. This is as it should be. Now if the subscriber speaks into his transmitter. Then the current from his telephone will flow from the line to point 6-7, and divide. Assuming that coils (C) and (D) are each 100 ohms, and coil (A) is 100 ohms, and the receiver is 75 ohms, then there will be a difference in the direct current resistance of 25 ohms. On this account there would be a greater flow of current through the receiver and Coil "A" than through coils (D) and (C). This is as it should be, so that the operator hears the subscriber well.

In actual practice the coils are not so proportioned as shown in drawings 175 and 176. Coil (D) for instance is about 400 ohms and is wound non inductively over the Induction Coil. Since Coil (D) is non inductive it will have a minimum resistance to the flow of the alternating current induced in the secondary coils.

In Fig. 177 we have shown the arrangement of coils in the No. 24 Type Induction Coil. The coils are wound on two separate cores, and placed parallel to each other on the one block. The two Primary coils are connected in parallel. They are also so connected that they induce currents in the secondary windings, so that the induced current in Coil (A) is in the same direction as in Coil (C). Suppose the primary windings have been discon-

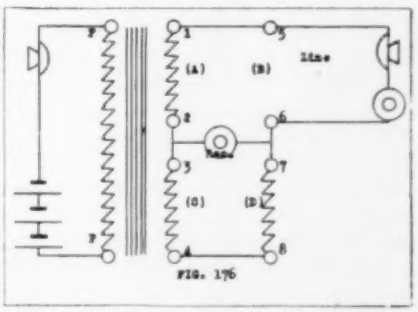


FIG. 176

nected for repairs. Then it is necessary to connect them properly. To test out the coils, connect a receiver across 1 and 7 in Fig. 177. Connect a tone to the primary coils connected in parallel. Then reverse the wires on one of the primary coils and notice the difference. Connect the primary coils so that the loudest tone is heard in the receiver. The two secondary coils must be tested together to see if the primary coils are correct.

Terminals 1-5 are usually marked (L). Terminals 3-2 are marked (T) for Telephone or receiver, and terminal 7 is marked (L.T.) for Line and Telephone. Connecting such coil in place of the type shown in Fig. 172, it is necessary to run a pair of twisted wires from the Operator's Jack to the Induction Coil, as well as a twisted pair from the Keyboard. This results in one wire on Terminal (L), one on Terminal (T) and two wires on Terminal (L.T.). Such an induction coil will reduce the side tone to a point where it is not objectionable. This reduction in side tone gives the operator the impression of a set that is not talking well, and she will unconsciously raise her voice. This results in better transmission to the subscriber. This circuit is also quite sensitive to incoming currents from the subscriber's transmitter.

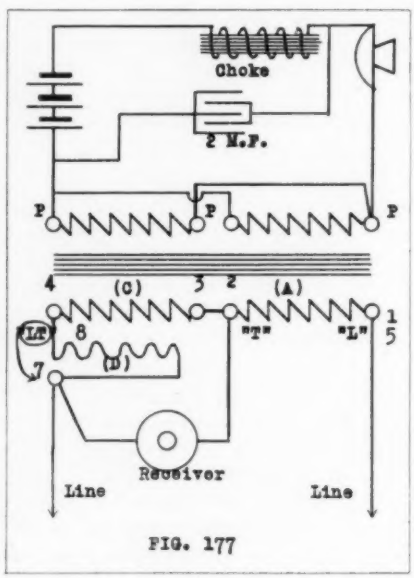


FIG. 177

The coil arrangement in Fig. 178 gives the idea of the noninductive winding. The current entering the coil on terminal 2 will traverse the coil in the opposite direction to the return current coming back at (1). If the number of turns are equal, the magnetic effect of the winding 2-3 is neutralized by the opposite magnetic effect of winding 1-3. Balanced noninductive coils have the two wires bound together with a light floss binding, and the two wires are then wound on the coil as one wire. Such a winding is used for Coil (D) in Fig. 176.

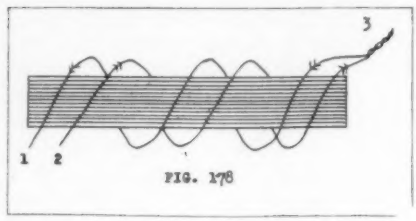


FIG. 178

In our next chapter we will discuss current supply for ringing in the small exchange.

New Form of Association Activity

In trade association work the district convention has become an established method of maintaining working contact between the various elements of the industry. The Illinois Telephone Association inaugurated a new form of educational activity by holding a distinctly traffic conference at Carrollton, Ill., on Wednesday, July 11. This was a district conference devoted exclusively to traffic matters, and conducted by the general traffic supervisor of the association.

The sessions of the conference were held in the parlors of the First Presbyterian Church, there being 56 operators and traffic supervisors in attendance. Excellent addresses were delivered by Miss Marie Hall, Jacksonville, Ill., Mrs. Mable Drummond, Nebo, and Miss Gladys Hamilton, Jacksonville.

A most remarkable degree of interest was displayed by the young ladies present in the work of the conference. Each one was assigned a topic and was asked to give one thought on the topic assigned to her, and in each case this provoked a very interesting and profitable discussion.

At noon those in attendance met with the prominent social and business leaders of the city of Carrollton at a luncheon served by the ladies of the First Presbyterian Church, Mr. O. G. Woods, Jacksonville, acting as master of ceremonies, and introducing Mr. Hubbard, the mayor of Carrollton, who welcomed the visitors in a very happy way. The response to the address of welcome was given by Jay G. Mitchell, secretary-treasurer of the Illinois Telephone Association, and at the conclusion of the luncheon the sessions of the traffic conference were renewed.

It is believed that this form of association activity is one of great value and one which will be developed and augmented in the future.

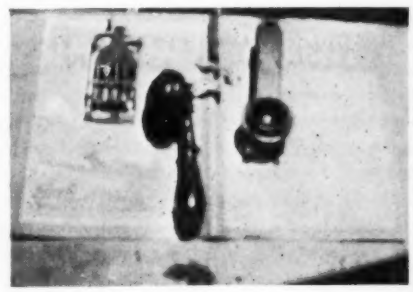
Telephone System Brought Million to Its Ownership

The Southwestern Home Telephone Company, with exchanges in Redlands, Calif., and in some of the smaller communities of Riverside county, and with its general offices in Redlands, was sold a short time ago, the buyer being the stockholders of the holding company known as the Western Utilities Corp.

Who Can Identify This Equipment?

Somewhere, some time, somebody somehow passed the equipment shown in the accompanying cut to E. C. Lewis, then representative of the Stromberg-Carlson Telephone Mfg. Co. This was some 28 years ago when Lewis was rambling over Ohio for the above firm; he doesn't remember who the donor was nor anything about the pedigree of the equipment, so we are passing it on to you for identification, make, age, etc. If you can give us the required information, and any additional that comes to your mind, both Mr. Lewis and J. K. Johnson, who now becomes the trustee of this property for the Independent Pioneer Association, will feel grateful.

Mr. Lewis, who will be remembered by many of the pioneers in the telephone business, formerly employed by the Stromberg-Carlson Telephone Mfg. Co.,



Type of 'phone used back in 19—? You tell us when

and later by the Automanuel Electric Company, remembers very little as to how he came into posession of this ancient equipment, except that it was given him by a friend in Ohio, who did not seem to know of its origin.

The equipment speaks for itself. Two receivers are shown, although only one belonged with the transmitter in the illustration. The receiver is shown hanging to a "trigger" hook, which automatically cut out the circuit when hung up, but the trigger had to be thrown when receiver was taken off the hook to begin conversation. Let's hear your explanation of the working of this apparatus.

Mr. Lewis is now with the Old Dearborn State Bank of Chicago, and will be glad to hear from you, or you may write this office direct.

Henry Ford Increases His Telephone Layout

The Ford plant has been equipped with the latest development in private branch exchange equipment. The old 600 line private branch exchange board in the River Rouge plant was given way to a new 1,200 line board which has been installed in the Administration building overlooking the mammoth Ford enterprises. This new office now links three other Ford plants and the Ford hospital.

The Vacuum Tube and Its Applications

By F. J. DOMMERQUE,
Fellow A. I. E. E.

General Description

As far back as 1884 Edison in one of his experiments with incandescent lamps introduced a metal plate or wire between the two sides of the filament in a bulb and observed the flow of current by the aid of a galvanometer. He found that, when he connected the outside terminal of the plate to the negative terminal of the filament, the galvanometer gave no indication of a flow of current, but when he connected it to the positive terminal of the filament a current would flow. We know now the reason for this; electrons evaporated from the incandescent filament and were attracted to the plate producing a flow of current when the plate was connected to the positive end of the filament, but were repelled when the plate was connected to the negative side of the filament.

The direction of *electron* flow is from a hot filament to the cold plate, while the direction of the *current* flow is in the reversed direction as current flows from a point or place of higher voltage to the point of lower voltage; in the above case the positive charged plate has the higher voltage and the filament the lower. It is always assumed that the tube or bulb presents a perfect vacuum.

At the beginning of this century Dr. De Forest inserted into the tube besides the filament and the plate a third electrode, which was called the "grid," and called this three-electrode tube the *"audion."* One of the earlier tubes is illustrated in Fig. 1, where the filament is in the center and the grid at both sides of the filament, the two halves of the grid having the appearance of a real grid. The plate also consisted of two halves positioned outside of the grid. The grid controls the discharge from the filament to the plate.

Fig. 2 gives a diagram of connections of a three-electrode tube. A battery furnishes current to heat the filament and serves to make the plate positive so that the electrons generated by means of the electric field migrate from the filament to the plate. As soon as an electromotive force is impressed upon the circuit containing the grid, the electric field existing between filament and plate is changed and at the same time the current in the plate circuit. If the grid becomes positive in respect to the filament, the electrons will move from the filament to the grid; some

*Transactions A. I. E. E., Feb., 1921.

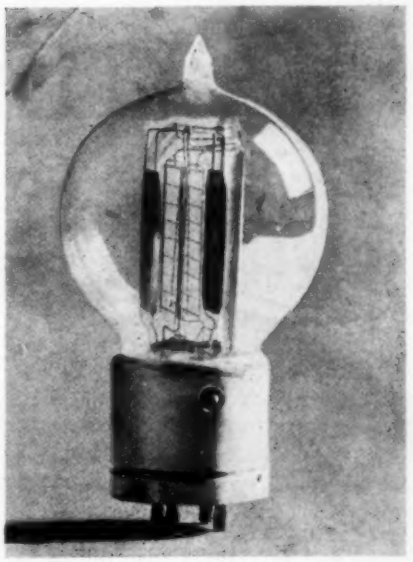


Fig. 1—Three-electrode tube of an early design

will be retained by the grid and cause a flow of current in the grid circuit, but the majority will pass through the grid and increase the plate current. If the grid, however, is made negative in respect to the filament, none of the electrons will migrate from the filament to the grid and the plate current will again decrease. Therefore during the time when the grid is negative, a change in its voltage will not influence its own current, but will influence the plate current. Here one can see a possibility of obtaining an energy output by a wattless change of the input voltage.

In order to facilitate the understanding of the amplification theory we will illustrate first the action taking place between filament and grid under the supposition that the plate is separated from the high voltage battery. When the filament is heated sufficiently to emit negatively charged electrons, and when the positive charge is slowly increased, the current flowing between these two electrodes will change equally as the potential E, as indicated in Fig. 3 by the part of the discharge curve marked M, which part may be designated as the period of the non-saturated electron emission. When the potential is increased, a point is reached, where a further increase will not produce a further increase in current. This part designated on the discharge curve by N is the saturation electron current. Next a point is reached where the ionization by collision of the gas molecules commences; this period marked by O is the gaseous ionization. The magnitude of the ionization depends on the tube dimensions, on the degree of vacuum and on the plate voltage.

The number of electrons emitted at a temperature T is expressed by the formula

$$N = AT^{c} \epsilon^{-\frac{b}{T}}$$

and the saturation current by Richardson's formula

$$i = AT^{1/2} \epsilon^{-\frac{b}{T}}$$

wherein A is a constant, T the absolute temperature in degrees centigrade, ϵ the base of the napierian system of logarithms, b and c two constants defining the work performed when an electron evaporates from a heated surface. The preceding formulae are given to the reader not because it is believed that he ever will have occasion to use them, but to guide the more scientifically inclined to seek further information in books like Van der Bijl's Thermionic Vacuum Tube, and Scott-Taggart's Thermionic Tubes for Radio Telephony and Telegraphy.

In Fig. 2 three batteries are shown. The A-battery serves for heating the filament, it usually is a six-volt battery, sometimes it has three and one-half volts only. The B-battery is of higher voltage and has the purpose to charge the plate. The voltage of this battery depends upon the type of tube and the requirements it is used for, it may range from 40 to 200 volts, in no case should it be less than 20 volts. The C-battery serves to charge the grid. From the figure we learn that there

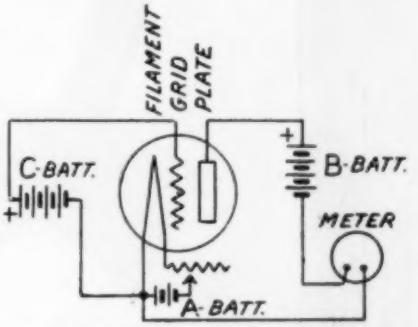


Fig. 2—Circuit of three-electrode tube

is a grid circuit containing the grid, the filament and the C-battery. This circuit is often referred to as the input circuit.

Armored Agst

The slate paint that completely covers the cable is fireproof and moisture-proof and forms an outer protection that successfully resists deterioration in any form.

The cable is made up of pairs gauge tinned and enameled color coated braid, twisted into baked until all the moisture is It is then immersed in beeswax for thirty minutes. Four 8-thread cotton strands are around the cable and it is with a white cotton braid and with a special slate paint that fire-proof, moisture-proof and

Cable can be furnished in the following sizes: 6 pair, 11 pair, 16 pair, 21 pair, 26 pair, 51 pair, 102 pair, 21 quad.

gst All Enemies

THE exceptional durability of American Electric Cable is due to the special attention given to every detail of construction. The strict specifications are the results of years of experience in supplying run-way cable and the resulting accumulated knowledge of the usual destructive causes. To overcome these natural enemies, we have developed special materials and manufacturing processes that result in a product that will serve you with unimpaired efficiency year in and year out.

An excellent example of the care taken in each detail is shown in the selection of the dyes used for color-coding the insulation of the conductors. These dyes are of a special formula to withstand the heat to which they are subjected when the cable is immersed in beeswax. They retain their true colors without fading and the conductors may always be identified even after years of use.

The enameling of the conductors is done by a special process that provides a hard and durable covering for each wire that will not crack even under conditions of excessive humidity. Yet, when necessary for terminating, this enamel may easily be removed. The tinning of each conductor simplifies the soldering and further facilitates the terminating of the cable.

American Electric Company, Inc.

State and 64th Streets Chicago, U. S. A.

Branch Office and Warehouse--
7th and Wyandotte Streets, Kansas City, Mo.

The plate circuit contains the plate, the filament, the B-battery and sometimes an ammeter or galvanometer, more often a telephone receiver. This circuit is also designated as output circuit. The filament circuit consisting of the filament and A-battery is mostly provided with a rheostat in series with the filament for the purpose of current regulation as the voltage of the A-battery changes with discharge; and often also with an iron-resistance for automatic regulation of the current, as the resistance of the iron wire increases very nearly in proportion to the increase in temperature.

Filaments are made of either metal wire like tungsten or Wolfram, or of a thin strip or wire of platinum or iridium coated with certain oxides. The latter kind evaporate electrons at much lower temperature than pure metal filaments. In fact oxide coated filaments for emission of the same number of electrons in a given time need only half as much power as do pure metal filaments.

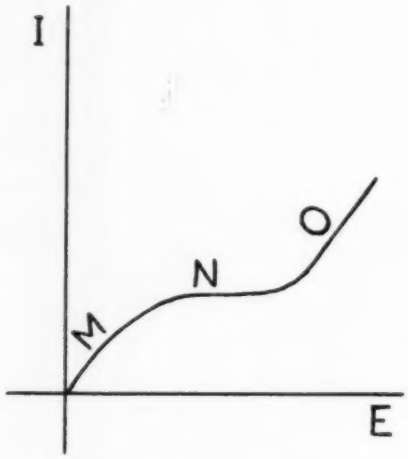


Fig. 3—Electron discharge current curve

The Vacuum Tube as an Amplifier

Connecting the plate to the B-battery and charging it positively above the saturation point gives cause to the following action: During the period M or O of the curve in Fig. 3 a small increase in E will effect a considerable increase of I; for this reason a slight amount of energy flowing through the grid will cause a considerable change in the current flowing from the filament to the plate. The grid, when charged negatively, will not pass any electrons. When the negative charge is diminished and when the grid approaches zero potential, a few electrons will escape through the grid to the plate; the number of the electrons escaping through the grid increases in accordance with part M of the curve until the grid has reached zero potential, when the electron current to the plate is the same as when no grid were present. As soon as the grid potential becomes positive, the flow of current commences to decrease again as the grid absorbs more and more electrons. Thus a small change from zero potential in either direction will cause a considerable change in the amount of ionization and thereby a considerable

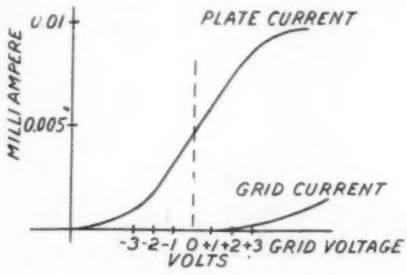


Fig. 4—Characteristic tube curve

flow of current to the plate as a consequence of the successive ionizations brought about by the electrons escaping through the grid. In this way an *amplification* is set going. The characteristic relation between grid voltage E and plate current I is represented by the curve marked "Plate current" in Fig. 4. The milliampere scale in the figure does not relate to any certain tube but gives only relative values. The proper values for any tube can be determined by keeping the value of the B-battery constant changing the value of the C-battery from a few volts on the negative side to zero, and then to a few volts further on the positive side. Plotting these values the plate current curve is obtained, which is of great importance as it permits to ascertain the actions of the tube.

In Fig. 4 also the grid current curve is drawn. It will be noticed that the current values are very small, so small indeed that they may be neglected with the possible exception of sending tubes of large dimensions. If the grid is given a positive charge, it will absorb electrons which will form a loss to the plate; the resulting grid current, however, remains small.

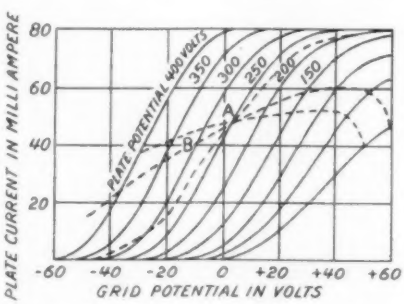


Fig. 5—Static characteristics for different plate potentials

For each value of plate voltage and filament temperature a pair of characteristic curves is obtained. Keeping the filament temperature constant and varying the plate voltage produces a family of curves, all of which have the same formation, only the current values are different. The higher the plate voltage, the greater the displacement of the curve to the left. The full drawn curves in Fig. 5 give an idea of such a family of plate potential curves.

How the amplification is made use of in telephone work will be discussed in a separate paper, suffice it to state here that as the vacuum tube amplifies the sound to a considerable extent and thereby acts as a repeater, it amplifies in equal measure the distortions due to lack of uniformity of the line characteristics. It is, therefore, the first requirement for satisfactory transmission of speech over long distances to balance the line portions on either side of the repeater against each other. A perfect balance is never obtained, but there is a limit which must be conformed to, otherwise "singing" will be the result, that is, one particular tone will become so pronounced that conversation is made impossible. To effect a satisfactory line balance on both sides of the repeater, balancing networks are placed to good advantage, thereby producing symmetry of lines.

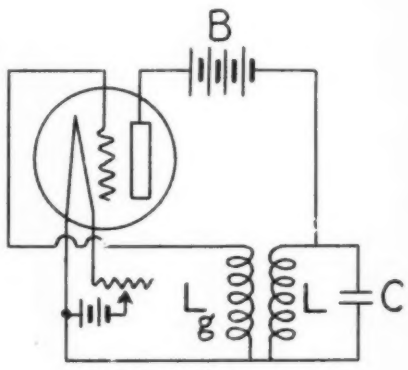


Fig. 6—Oscillator circuit

The Vacuum Tube as Oscillator

About the middle of the last century Henry showed at Princeton that electric motions will be oscillatory under certain conditions. Electric oscillations may be obtained in an electric circuit when the current in the circuit flows first in one direction through the circuit and then in the opposite direction, and when this change of directions alternates in regular cycles. If there were no losses of energy in the circuit, the oscillations would continue indefinitely, but there are losses in the source of power or in the wire; therefore, the losses accumulate and the oscillations finally die out. Such oscillations are designated as "damped" oscillations. To produce "undamped" oscillations, that is, oscillations or waves the amplitudes of which remain the same for each oscillation, the source of power must be arranged so as to keep on replenishing the loss of energy dissipated in the circuit. The property of the vacuum tube as an amplifier renders it also useful as a producer of undamped oscillations, such as are required in telephonic transmission.

As it is possible to obtain from a vacuum tube a greater energy output than there was put in the tube, it should be possible also to use part of this output again as input and thereby increase the output energy. If we succeed to introduce part of the output energy again as input energy and do it in sufficient quantity and under proper phase conditions, we would obtain a continuous amplification and the result would be undamped oscillations without the requirement from an outside source of effecting potential variations in the grid. Many ways have been found how this regeneration can be accomplished. We will describe only the fundamental form.

In Fig. 6 the grid is connected to the filament by means of a coil L_g; the latter is coupled inductively to the coil L of the plate circuit. It may be opportune to insert here a few explanations: First, about coupling. Linking together of two circuits by means of a magnetic or electric field is called in the parlance of modern physics "coupling." We speak of different kinds of coupling according to the device used for coupling. An "inductive" coupling employs an induction coil as coupler; a "capacitive" coupling a condenser and a "resistance" coupling a resistance. The coupling may be "direct" or "indirect." If the two circuits have an inductance coil in common, that is, one coil only instead of two (in Fig. 6 there are two coils) we have a direct inductive coupling. If they have a condenser in common we have a direct capacitive coupling. With two coils, or with more than one condenser (often each circuit contains two condensers in series where one of the condensers in one circuit is coupled to one of the condensers in the other circuit through a coupling condenser) we have an indirect inductive or capacitive coupling, as the case may be. The term "indirect" is mostly omitted in descriptions and discussions.

A circuit possessing inductance and capacity connected as shown in Fig. 6 marked by L and C, forms an oscillation circuit. On closing the plate circuit of the tube the first current impulse will set in motion an oscillation in the oscillation circuit L-C and an e.m.f will be produced in the coil L_g, which may be designated by "e." If this e.m.f. and the e.m.f. in the oscillation circuit L-C are alike and in phase, the oscillation will continue "undamped"; if, however, the e.m.f which makes the oscillation circuit L-C oscillate, is greater than the e.m.f. of the oscillation circuit itself, the amplitude of the oscillation in the oscillation circuit will increase and also the e.m.f. "e." This increase will continue until the variations of the grid potential have gone over the entire part of the tube characteristic between lower and upper bend in the curve, Fig. 4, when the increase ceases. The frequency is determined by the magnitude of L and C. High frequencies, such as produced by the vacuum tube, are utilized in carrier current and multiplex telephony.

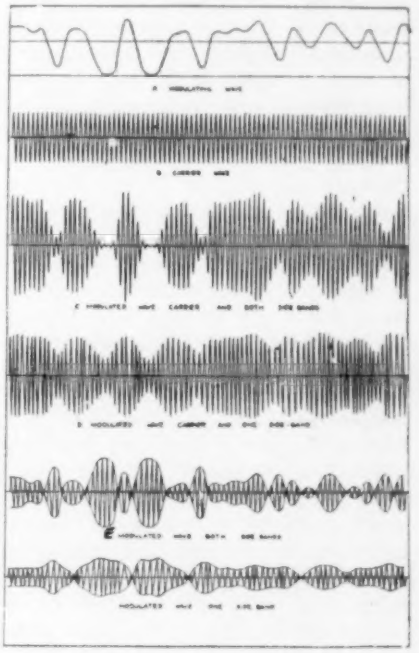
To study the conditions necessary to render the tube an oscillator we will refer to Figs. 2 and 5. Assuming the external plate circuit in Fig. 2 to possess neither resistance nor impedance, then the plate-potential E_p would be equal to the e.m.f. E_B of the B-battery and the alternating current grid potential e_g would produce synchronous variations in the plate current corresponding to the plate potential E_B, over the static tube characteristic curve. Placing an impedance Z in the plate circuit, consisting simply of a resistance r, will make the e.m.f. E_B equal to the loss in potential $= r\ I_p$ (where I_p designates the current flowing in the plate circuit), plus $I_pR = E_p$, between filament and plate. Whence $E_B = rI_p + E_p$ or $E_p = E_B - rI_p$, which expresses the difference of potential between plate and filament. Varying the grid potential E_g increases the current I_p in the plate circuit and the resistance loss rI_p in the external plate circuit increases correspondingly. If, therefore, the battery potential E_B remains constant the plate potential E_p will decrease. On the other hand, when I_p decreases with increasing grid potential, the plate potential E_p will increase and consequently is not constant any more due to the external resistance of the plate circuit; it varies inversely as the plate current. The result is a so-called "negative resistance."

The grid potential and plate current vary in synchronism, but the plate potential is displaced by 180°. To render the circuit indicated in Fig. 6 continuously oscillating, the internal resistance of the current changing from filament to plate must be negative, that is, its absolute value must stay below $\frac{L}{RC}$, whence the condition $r < -\frac{L}{RC}$. The coil L_g is to be connected so as to make the mutual induction of the two coils forming the transformer negative.

Taking in Fig. 5 the point A as operating point of the tube at a certain instant of the oscillation period, the grid potential will oscillate in each period between two extreme limits; the point A, however, will not follow the path of the static tube characteristic as the plate potential varies in proportion to the grid potential and in reversed direction, but will proceed along the lines of a dynamic characteristic. This characteristic presents for a certain tube the plate current as a function of the grid potential and the variations of plate current and grid potential, which are in phase. Three such dynamic curves are drawn in Fig. 5 in dotted lines for three different proportions of plate—to grid-potential, namely, 5 to 1, 4 to 1 and 2 to 1. The assumed point A moves from A to B. Each one of the three curves corresponds to a certain coupling value of the two coils L and L_g. The variations in grid and plate potential are proportional to each other. To shape this variation so that their direction and polarity are reversed and at the same time the tube resistance has a negative effect, also the mutual induction effect of the two coils must be made negative, that is, designating the coupling value by M, the resistance of the oscillation circuit by R, its induction by L, its capacity by C, the internal plate resistance of the tube by R_i and the amplification factor of the tube by M, it must be $M < -\frac{L + CRR_i}{M}$.

We learn from Van der Bijl that M is a constant, at least it may be considered constant for all usual voltages. This factor may be defined as the ratio of plate and grid voltage changes which produce an identical change of the plate current. Its value is given by Van der Bijl as $M = Cprn^2 + 1$, wherein

p = distance between plate and grid;
r = diameter of grid wires;
n = number of grid wires per unit of length:
C = a constant; in the tube illustrated in Fig. 1 it would have the value 80



Carrier wave modulation

The Vacuum Tube as Modulator

As is well known, sound waves by the use of the transmitter are transformed into electric waves. A transmitter contains two electrodes, one of which is fixed and the other one movable. The latter is attached to the diaphragm. Between the two electrodes carbon granules are inserted, which form a conductor. The transmitter circuit is completed by the

battery. The sound waves set the diaphragm in motion; it moves forward and backward and exerts a pressure upon the carbon granules, the resistance of the carbon varying thereby in unison with the sound vibrations. These current variations effect a transformation of the continuous current flowing through the transmitter into a pulsating current which takes the wave form of the speech. If the magnet winding of a receiver is connected with this circuit, sounds will be produced in the receiver due to the current "variations," the "continuous" current would not produce a sound. We have, therefore, in the transmitter an instrument which can by an action which is called "*Modulation*" give to a direct current the form of the speech wave, which is an alternating current wave in the audible range of frequencies. The currents prevailing in the ordinary transmission of speech have a frequency range from 200 to, say, 3,000 periods per second. They are often called "audio" frequencies and are perceptible by the human ear, while frequencies above this range are not any more perceptible; the latter are often designated as "radio" frequencies, because they are used in wireless or radio telephony, but they are also used in carrier current telephony. In the case of radio and also of carrier current telephony the high frequency waves correspond to the direct or continuous current in ordinary telephony over wires, neither of them is heard in the receiver, only when those currents have been modulated, that is, when they have been given the speech form, the "changes" in the currents are perceptible by the ear. The first requirement is, therefore, that when the modulated wave arrives at the receiving end, the original low frequency wave must be separated from the carrier frequency wave, that is, the arriving wave must be "de-modulated." The frequencies in the speech range can appear in the receiving circuit only as the differences of the two components of the modulated wave. Subtracting the carrier frequency from any one of the components of the speech wave gives the original speech frequency which originated this component. As the amplitudes of the side band components are proportional to the original speech components and as the amplitude of the carrier current remains the same for all components, the combined action of the carrier and the entire upper side band will reproduce all speech waves components and their associated relative amplitudes. The same process holds good for the combined action of carrier and lower side band. Consequently only one of the two side bands is required for the reproduction of speech. As an illustration we insert a sheet of curves from a paper by Colquitts and Blackwell*. "A" represents a modulating wave of irregular form which is representative of the speech current; "B" represents a carrier wave; "C" the resulting modulated wave whose envelope has the form of the modulating wave; "D" the modulated carrier wave and the effect exerted upon the wave form by the suppression of a side band; "E" the modulated wave with both side bands; "F" the modulated wave with one side band. The function performed by the vacuum tube in the de-modulating process is practically a rectifying action; therefore, the de-modulator tube can be designated as rectifier.

Ramblings

By J. A. S.

J. E. Farnsworth, vice-president of the Southwestern Bell in Texas, was a Chicago visitor during July. He was on his way from Battle Creek to California, where he plans to spend the summer. "Uncle Joe" has rounded out almost forty years with the Bell interests, beginning at the bottom and gradually climbed up. TELEPHONE ENGINEER acknowledges a call from Mr. Farnsworth while in Chicago.

* * *

A. C. Stuart of Texarkana, Texas, and general manager of the Three States Telephone Company, operating in many cities and towns in Texas, has returned to his home after spending a month at Battle Creek for his health. He is reported as much improved but will spend the summer in the Ozarks of Arkansas. Stuart is a climber.

* * *

F. N. Hoag, General Commercial Superintendent of the Southwestern Bell at St. Louis and Howard Leinard of Cleveland, Ohio, were callers at the TELEPHONE ENGINEER office during July. Mr. Hoag is a former Texan and we had many things to discuss during the short time he was here.

* * *

Thanks to the co-operation of the patrons of TELEPHONE ENGINEER, the writer will be enabled to attend the Erie convention August 8-10, and from there will visit Niagara Falls and other points. TELEPHONE ENGINEER advertisers comprise the cream of the manufacturing and selling end of the industry.

* * *

W. S. Vivian is always "in" when a telephone man calls at his office in Chicago. He is just as full of pep as ever and indicated that he would probably be "handshaking" at the Erie convention in August. As was to be expected Vivian is in no way connected with the investigation of the power industry.

* * *

H. N. Faris just can't keep still; he works all the time, and thinks while he sleeps. TELEPHONE ENGINEER this month carries an article from Mr. Faris describing a new Kellogg Switchboard installed way out in Kansas—but that is where Faris lives, or where his wife lives —he's too busy to stay anywhere. Faris is better known in the Southwest, where he has spent many years calling on the telephone trade. He is is now technical engineer of the Central Kansas Telephone company.

* * *

And C. A. Rolfe, passes out of the picture as far as ownership of the Redlands, California, property is concerned. He is still retained as manager of the properties, but confesses that he does not know what the future holds forth for his former company—and for him. This was another property that was built by the sweat of the face, and its final sale netted the owners a round million dollars, and we hope Rolfe owned every bit of it. Mr. Rolfe has been a regular wheel horse at state and national conventions, and we regret to see him abandon the great industry in which he has been such a power.

* * *

C. A. Shock, vice-president and general manager of the Northern Texas Telephone Company, with headquarters at Sherman, Texas, was able to act as host to the district meeting of the Texas Independent Telephone Association recently, after several weeks' confinement in a hospital. An operation for appendicitis brought about the enforced "vacation."

* * *

Frank Runyan, supervisor of maintenance of the Oklahoma Telephone Company, Hominy, Oklahoma, succumbed to an attack of cerebral hemorrage early in July. Runyan was formerly employed in Kansas, and the funeral was held at Jewell, Kansas. He was a friend of the writer for many years and his passing is keenly felt.

* * *

Frank T. Singleton of Martinsville, Ind., is to serve another four years as a member of the Indiana Public Service Commission, he having been reappointed by Governor Jackson recently. Singleton is well qualified to pass on matters pertaining to the telephone industry. Here's hoping he rounds out four more years of service and still retains the best wishes of the industry as a whole.

* * *

Ray Blain, who has contributed articles to TELEPHONE ENGINEER from time to time, has another interesting comment in the August issue on articles appearing in our "Line and Desk" department. Blaine is connected with the Signal Corps of the Fifth Corps Area, stationed at Fort Hayes, Columbus, Ohio. He knows his vegetables when it comes to engineering.

LINE AND DESK

SOME TYPICAL AVOIDABLE MINOR ACCIDENTS

A review of some of the recent accidents reported shows that if care had been taken the injuries could have been avoided:

(1) "I had climbed pole to lay two wires over cross arm. I did not use safety strap but caught hold of cross-arm brace and after I had put the second wire over the arm, the screw holding brace to pole broke and I fell 12 feet to the ground."

Do not trust your weight on cross-arm braces or other fixtures unless you know they are safe. For an experienced lineman the job was one that required the use of a safety strap. Learn to depend on the pole for your support, and you will find that your work can be done with safety and comfort to yourself.

(2) "While trimming the small limbs off of a tree, preparing to cut it down, I struck at the small sprouts with my chop axe and one of them in some way struck me in my right eye."

This man does not seem to know why one of the sprouts hit him in the eye, but when he thinks about it, he will realize that he failed to use the precaution of cutting the sprout close to the body of the tree. It was the force of the lick that whipped the sprout down against his face.—Southern Telephone News.

MORE ABOUT GROUND CONNECTION

Ray Blain, one of our regular contributors, offers the following comment on the subject of ground connection:

"I am going to take the opportunity of making a few remarks regarding ground connections as mentioned by an unknown contributor under "Line and Desk" in July TELEPHONE ENGINEER. Now there was some very good information contained in the above-mentioned article and I don't intend any offense, but when you mention two perfect grounds at the central office, does it mean a ground connection without resistance? Personally I have always considered a ground connection of less than four ohms satisfactory. Then, with reference to the zero measurement between the two grounds, is this possible?

The same article mentions the fact that coke or charcoal buried with the ground will hold water when all around is dried out, also that ground rods after they have formed a coat of rust increase in resistance and are only reliable in earth that is wet the year around. Now some few years ago the Bureau of Standards made exhaustive studies in ground connections which brought out some very interesting facts. These were written up, I believe in technological paper No. 108. These tests were made in various districts throughout the United States and it was found that a driven pipe in most cases gave results equal to a buried plate. They also claimed that charcoal or coke did not improve a ground connection, that it will not store up a greater volume of moisture than the same amount of earth, or retain it any longer. Now the third strike and I know I am out. That the rust on a ground rod does not increase its resistance to any extent, however, paint or grease on any kind of a rod will cause a faulty connection with the earth and a high resistance will result. The galvanized iron or copper clad rod does, however, have the advantage of a much longer life than the black iron rod.

Now I do not intend to infer that the Bureau of Standards cannot make a mistake, but they have a bunch of fine fellows up there with every available resource and I have always placed great confidence in their information."

SOME TOUGH JOBS ON PRIVATE RIGHT OF WAY

Cable construction on private right of way in certain parts of Michigan offers some real problems for the construction force according to O. Mann in a recent number of the *Mouthpiece*.

Mr. Mann says: "Private right-of-way work harbors a multitude of tough jobs for the plant man, but it has its compensations, if you are a lover of nature. In fact, the past spring and winter some of us in the central division have been so close to nature several times that we have had to be pulled out. Others have written themes on the private right-of-way job, so I will attempt to touch upon points not already covered.

It is almost necessary that a job on private right-of-way be done while the frost is in the ground, which means that engineering must be done, right-of-way bought and material ordered well in advance of construction work. All that can be regulated, but weather conditions are somewhat different. They will change, no matter what the regulations or preparation.

Old Methods Necessary

No strand is distributed on the job, as we have found from past experience that that is rather expensive, due to the fact that the reels vary in length, often making it necessary to move a reel to a new location, which might mean in another field, over a fence or in a swamp.

The spotting of cable reels requires considerable thought, as the location of pull may be in the center of a plowed field, swamp, woods, or on top of a hill. A winch, for this type of construction, is almost indispensable. Pulling in cable on private right-of-way isn't as easy as it may appear, for in a great many cases it is necessary to carry the jacks and other tools to the set-up by hand and then to use teams, with a traveling block, to pull the cable through the rings.

We also are confronted with the problem of solid and single-tired trucks breaking through the frost. In many places, where there is nothing to throw a hitch on, it is necessary to get another truck to winch them out. We find that for soft dirt roads and private right-of-way, dual pneumatic tires are far superior to anything else we have used."

Anchors Must Be Good

In order to take advantage of the most favorable weather conditions, it is necessary that someone become familiar with crossroads, lanes, etc., the information to be given to the foreman in charge of the work. Then poles are hauled out on trucks to the crossroads and hauled from there to the job with teams and stoneboats, generally by the farmers. At all times we work very closely with the property-owners.

As we all know, anchors are the backbone of a pole line, and that presents problems in the open fields, where it usually is necessary to use hand pumps while digging holes. Large pieces of concrete are placed on the anchor, to keep it from "floating away." It is somewhat different to place an anchor in a field or swamp than on a street, as in the latter case there is always drainage of some sort. In the fields we often have water on top of the ground.

Electrical Policeman

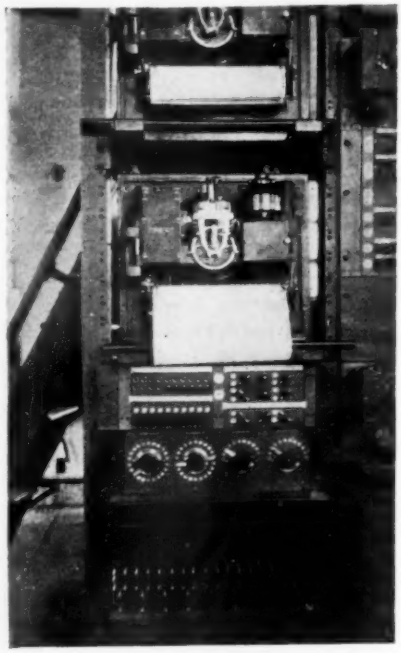
Master Transmission Regulator Keeps a Weather Eye on Telephone Circuits, Explains I. E. Lattimer, New York

Telephone circuits, like human beings, react to weather conditions. On hot summer days, they conduct their business with somewhat lessened efficiency and, doubtless wish, if telephone circuits can wish, for more comfortable weather. In the crisp, bracing days of winter they are at their best. To be sure, this variable attitude toward business is not of great consequence when the circuits are in open wire or where cable is involved, if the cable is not too long. In these cases fairly simple disciplinary methods, applied on judicious and quite widely separated occasions, serve to keep them up to the mark. And nobody, except those in the family, ever knows the difference.

But conditions change and, with a rapidly growing telephone business, cables are getting longer and longer. There is a veritable net work of long distance cables covering the northeastern part of the United States and branches of this network are creeping out into other sections. They are stretching out from Chicago toward Minneapolis and Omaha. They have reached St. Louis and are even starting out of town from there in a cautious, but none the less positive way.

The result of all this is that the lengths of the long distance telephone circuits in cable have become such that it is no longer possible to deal, by simple means, with the effects of temperature changes. The changes between night and day are liable to be too much to tolerate and, between summer and winter, they are simply out of the question. For instance, a Chicago-New York cable circuit, which would provide a perfectly satisfactory talk in winter, would be absolutely useless in summer without suitable compensation.

These changes are due to a simple but fundamental fact we learned in our high school physics days. That is, that the ability of a copper wire to conduct electricity decreases if heated and increases if cooled. Since the prime business of a telephone circuit is to conduct electricity, this is, naturally, a very important matter. The smaller the wire, the greater is its resistance and, therefore, the more there is to change. The wires in cables are small compared with open wire, and that is why the cable circuits are more seriously affected than open wire circuits. The net effect caused by hotter weather is to tend to make the telephone circuit sound "distant," unless something is done to offset this tendency.



The electrical policeman—otherwise Master Transmission Regulator—poses for its picture

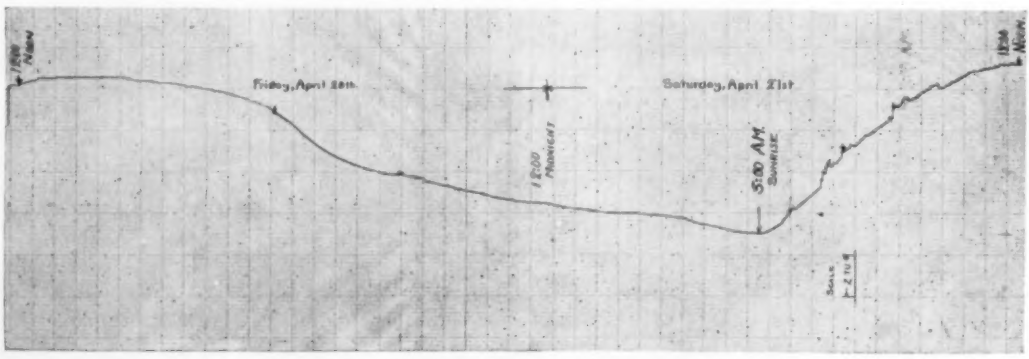
Long telephone circuits in cable have telephone repeaters on them every fifty or 100 miles, to make up for the loss the voice currents normally suffer in transmission. As the amplification or "gain" of these repeaters is adjustable, this offers a very satisfactory means for control of this troublesome temperature factor. As it is impracticable to make all the necessary adjustments by hand, the Bell System engineers developed a means by which these adjustments are made automatically.

One pair of wires in a section of cable, perhaps 200 miles long, is selected as a "pilot wire." A device known as a master transmission regulator, is then connected to it, usually at some centrally located cable repeater office. This master regulator comprises an electrical circuit similar to what we also met in our high school physics days under the name of a "Wheatstone bridge," used universally to measure resistance of electrical circuits.

In the case of the master regulator it is connected so as to measure the resistance of the pilot wire. It will be recalled that when a Wheatstone bridge has been adjusted or "balanced," so that the desired measurement has been obtained, this is indicated by the fact that the needle of the galvanometer stands in its zero or central position. If the bridge is unbalanced by changing the resistance of the circuit being measured, the needle moves away to one side or the other of its central position, depending on whether the resistance of the circuit is increased or decreased.

So, in the case of the pilot wire, any change in resistance, due to a change in temperature, immediately affects the bridge in the master regulator, causing a deflection of the galvanometer needle. When this needle has deflected a certain distance an electrical contact is moved. This operates relays which make a slight change in the amplification of all the repeaters in that office which are associated with circuits in the same cable and, therefore, are exposed to the same changes in temperature.

Having performed its duty by bring-



Section of Transmission Regulator chart, showing variation in transmission equivalent in about 200 miles of 19-gauge cable circuit during a 24-hour period, as registered by automatic recording device

ing the telephone circuits back to their proper adjustment, the needle returns to its normal position to wait further developments needing its attention. The return to normal position is brought about by the fact that, at the same time the amplification of the various repeaters is adjusted, the resistance in the balancing arm of the bridge is also adjusted automatically. The regulator, therefore, returns to a condition of equilibrium. The needle may not remain long inactive as temperature along a cable continually varies, and it will not be long before the needle is swinging away from its central position, indicating a change in resistance. This will soon require an adjustment of the repeaters in order to prevent its effects becoming noticeable to a telephone user.

These master regulators are installed in stations from 100 to 200 miles apart along the cable route, depending upon the length of cable section assigned to the attention of each regulator. The mechanism of the regulator, shown in the accompanying illustration, is protected from dust and injury by inclosing it in a glass case where, month after month, it goes on efficiently performing its mission in life.

Because of the important position it occupies, the regulator is required to keep a continual written record of its activities. This it does by drawing a wavering ink line on a slowly moving strip of paper. This strip of paper can be seen in the center of the machine pictured, while a section of a typical strip is reproduced on this page. From this line, at the end of the day, can be read an accurate story of the caprices of the telephone circuits and of the faithfulness of the regulator in keeping them on the job.

The range of control which a regulator can exert over a telephone circuit is sufficient for all normal conditions but, due to troubles developing, the situation sometimes gets beyond the ability of the regulator to handle it by ordinary methods. In such a case, it hesitates not at all, but promptly sends in a riot call for the assistance of the station attendants, by ringing an alarm. At the same time it makes a careful record of the matter for future reference.

As a final word, it may well be said that the present state of development of the long distance telephone cables would have been unattainable without the help of these electrical policemen—the transmission regulators.—Republished from Long Lines.

AND NO STREET CARS!

When Noah sailed the water blue
He had his troubles, same as you.
For forty days he drove the Ark
Before he found a place to park.

A SMALL VOLTMETER TESTING OUTFIT

I recently hooked up a testing circuit for a common battery plant, mounting it on the face of the switchboard, within easy reach of the operator. The point in view being that a small plant hardly justifies a test board, there being no man on the job there all the time. We send a man from another exchange to clear trouble at the exchange in question.

We have found that with the tester we use a regular switchboard plug, insert it in the line jack of the line in trouble and quickly ascertain whether there is a ground, short, open, or a good line.

I have three keys on the instrument, one for short, one for double throw for testing for ground on either tip or ring of line, and a reverse key with which we test for "condenser kick."

Also a lamp is placed in the circuit so that should a ground be on the tip we can throw the reverse key before going out on the line and if the lineman is in an isolated spot he can call in on the line in trouble, which will bring in the lamp on the testing instrument.

We have found this method of testing very satisfactory and should you think it of sufficient value and interest to operating men of small plants I would be glad to draw the circuit and send itemized explanation of operation. I should add that a small voltmeter is used on the instrument, the cost of the other parts being negligible and the meter itself an inexpensive one.—Contributed by Ernest Wommack.

(Send along the circuit and description, Mr. Wommack. We are sure that many will be interested.—Ed. "Line and Desk.")

Sale Approval of Two Telephone Firms Asked

Petitions of the South Central Telephone Company, Inc., for approval by the Alabama Public Service Commission of the sale of the Center Ala., telephone system by M. Brotherton to the South Central Telephone Company and of the sale of the Lincoln, Ala., telephone system by W. D. Davis to the same company, were heard by the commission yesterday and taken under advisement.

Petitions of the South Central Telephone Company, Inc., for approval of the sale of the Linden, Ala., telephone system to it by M. B. Morton and of the Thomaston, Ala., telephone system to it by M. B. Morton were both dismissed upon the motion of the petitioner.

The Thomaston Telephone Company's petition for approval of the sale of the Linden Telephone system by the Thomaston Telephone Company to M. Brotherton was heard and taken under advisement.

Expert Invents Magnetic Probe

The humanitarian spirit of the telephone's inventor, Alexander Graham Bell, which marked his lifelong activity in behalf of those with lost or impaired hearing, has frequently been reflected in many of the auxiliary products of telephone development. From the research of the Bell System scientific laboratories and co-operating medical experts have come the electrical stethoscope, the artificial larynx, the audiometer and aids to the deaf. Now comes another humanitarian instrument—the magnetic probe. It has nothing to do with telephony, as such, but is a by-product of developments in the manufacture of telephone apparatus. It is a beneficent instrument, made available to physicians for the removal of steel slivers from the skin or the eye without the necessity of surgery. —Antioch, Ill., News, July 19.

Revised Phone Service Schedule Approved

A revised schedule of service connection charges submitted by the Indiana Bell Telephone Company Monday was approved by the public service commission.

The reductions include a decrease from $3.50 to $3 for the modified service connection charge on individual or party residence lines; first charge on extension station business phones reduced from $3.50 to $2 and residence from $3.50 to $1.25; service charge on private branch exchange phones from $3.50 to $2 and on residence connection from $3.50 to $1.25 and trunk connection with private branch exchange from $3.50 to $3. It was explained that the reduction will mean changing the location of a telephone set on the same premises for only $1.25 as compared to $3 before with a smiliar charge for changing the type of instrument.

John H. Wright Heads Commercial Enterprise at Jamestown

John H. Wright, of Jamestown, N. Y., vice-president and general manager of the Jamestown Telephone Corporation, was last week named president of the Hollow Metal Construction Company of Jamestown. The concern will manufacture adjustable metal office partitions. This will be one of the important manufacturing enterprises for Jamestown, and that city has many large manufacturing concerns.

The Jamestown Morning Post, in mentioning the formation of the enterprise, states that the capitalization of the concern is $500,000 00, and has a floor capacity of 61,000 feet, with four acres of ground for expansion and 800 feet of railroad frontage.

Co-Operation in the Telephone Industry*

By G. M. KLOIDY,
Secretary, The Nebraska Telephone Association

The lover of romance and adventure will not find in the pages of fiction any narrative to surpass in breathless interest and astouning revelations the history of the telephone. The toy of half a century ago has grown to be the key to a treasure chest whose wealth surpasses precedent. This is not merely the accumulation of toil, but the joint product of genius and co-operation, of opportunities improved and advantages utilized.

Today, as people lift the receiver from their telephone, perhaps to carry on a conversation with some person a thousand or several thousand miles away, using merely the ordinary tone they would employ with a person in the same room, they give little thought to the years of patient effort, and the vast organization of trained men and women that have made this result possible. Yet back of this simple act of lifting the receiver from the hook and establishing communication with any one of millions of human beings on our great continent, there is a story that would put to shame any of the marvels recounted in the Arabian Nights. The telephone has played a part so vital in human progress that it has actually changed the entire course of history, and has vastly accelerated the progress of civilization, for which the great essentials are transportation and communication.

It is not surprising that the telephone has in no other country attained, under government ownership and operation, a development which approaches that achieved under private enterprise in the United States. Government departments lack incentives to seek business. The necessity for monetary profit is a stimulus without which the average enterprise will not do the best work. In governmental undertakings this stimulus is wholly absent. The United States has about six per cent of the world's population, and 63 per cent of the world's telephones. American supremacy in telephone development is attributable not only to the freedom which in this country is accorded to private enterprise, but to the progressive and co-operative spirit of the American people, a spirit which has emphasized the human element in telephone organization.

For the telephone is essentially an instrument of personal service, and its usefulness to the public is peculiarly dependent upon the spirit which animates the telephone personnel. A very graceful compliment is paid to the American telephone companies when it is stated that the telephone service in the United States of America is recognized as the most efficient service in the world.

Such a result could not be secured under a spirit of petty competition, ever ready and eager to throw obstacles in the way of another company and to detract from the efficiency of its service. Consider for a moment the intricacy of the present methods of telephone communication. Where the first toll circuits consisted of a few miles of open circuits, it would take several pages to describe a telephone circuit connecting Boston for example with Catalina Island or Havana. In addition to thousands of miles of open wire, there are hundreds of miles of cable either underground or aerial; there are loading coils to overcome the capacity of the cables; there are repeaters to supply new energy to the conversation on its long journey; there are submarine cables or wireless links to cross the rivers and the sea; and there are innumerable equipment devices in the many offices through which the calls must route.

The wires stretch across deserts and over mountains where they are frequently the only signs of civilization. When we consider that the slightest break in the thousands of miles of wire or in any of the pieces of apparatus would prevent a transcontinental conversation, it is a constant marvel that a telephone plant can be built and maintained with the necessary degree of perfection.

The work of operating a long distance call is also difficult, calling for a high degree of co-operation, often between a number of different companies. Such a call is an enormous stride from the early days of short toll circuits over which two operators could complete a call, whereas for present day transcontinental connections, from ten to sixteen or more operators are necessary. A call, for example, from Augusta, Maine, to Catalina Island must be switched at Portland, New York, Chicago, San Francisco, Los Angeles, and Long Beach, and the operating methods must be carefully worked out and the operators themselves must be expert in order that there may be perfect co-operation in such a call. That sort of call is a striking illustration of the necessity for uniform and standard operating methods, and for courtesy and co-operation between companies. Connected as they are in one vast chain, one telephone company depends upon the other for incessant and efficient service, and the acts of one company vitally affect the telephone industry as a whole.

The interest of the public and the interest of the individual companies are identical in the direction of economic and efficient service. Sound and effective management, therefore, involves co-operation between the variouse companies to produce this result. Properly considered, the management and operation of a telephone company is a trust and obligation to the public which must be fulfilled to the satisfaction of the public. And it is vastly to the credit of American telephone companies that they have shown themselves to be deserving of confidence by frank and straightforward dealings with the public, and the disposition to put service above personal gain.

The fact that the telephone company is the servant of the public is fundamental. All our efforts must be directed toward what will please and satisfy the people who are in reality our master. We must give good service. The only test we can apply to any practice or project under consideration is to resolve the question as to whether it is for the betterment of the service. We believe that the public wants the best service we can give, that it is willing to pay a fair price for good service, and that it does not want anything less than dependable service at any price.

The telephone business is no longer an experiment, it is a thriving industry and the telephone in the average home is not considered—as it was even a few years ago—a luxury but a necessity.

The time has passed when anyone, without any telephone knowledge or experience, may string a wire hap-hazard, hook up an instrument to either end of it and give service, so called to the public.

In this day and age the public expects and is entitled to receive the best in telephone service, and there are many qualified telephone men who would be glad to co-operate if consulted by the inexperienced, thus enabling the new and smaller companies to properly construct and maintain their lines, and conduct the business in a satisfactory manner.

Unfortunately for the complete success

*Address delivered at Oklahoma Telephone Convention, Mar. 13, 1928.

What is due the public

An Advertisement of the
American Telephone and Telegraph Company

THE Bell System recognizes the public requirement for a constantly extending and improving telephone service. Last year 4 million telephones were either put in or moved. The number of local calls not completed on the first attempt was reduced by 5 per cent. The average time for handling toll and long distance calls was reduced from 2 minutes to 1½ minutes.

During the last 5 years the Bell System spent $1,800,000,000 on additions, and improvements of its plant.

There is equally a public requirement for safety of principal and earnings of the stock of the American Telephone and Telegraph Company — the parent company of the Bell System. Since its incorporation in 1885 it has never missed paying a regular dividend to its stockholders, who now number more than 420,000.

The very nature of the telephone business necessitates a single interconnected system. The American Telephone and Telegraph Company accepts its responsibility for a nation-wide telephone service as a public trust. It is fundamental in the policy of the company that all earnings after regular dividends and a surplus for financial security be used to give more and better service to the public.

of the telephone business, many of the companies do not co-operate and properly maintain their lines and provide the equipment necessary to give good service, and it is only too true that very often it is almost impossible to transmit calls over their lines. Connecting as they do with other companies, they necessarily form a part of the telephone system, and yet the service they give is so poor as to form a blot on the entire telephone industry. This is the worm in the core of the telephone business, the canker which eats and destroys the work of better companies. Everything is judged by results, and if a call handled by the best equipped company in existence must be transmitted over the lines of one of these companies, the result is not satisfactory, and the blame falls not where it belongs but upon the industry as a whole, and the best telephone exchange on earth would be more or less of a failure, if surrounded by exchanges and toll lines that were failures.

It is the mission of the pioneers of the telephone industry and their successors and associates among all nations to build up a telephone system extending to every part of the world, connecting together all the peoples of the earth. This result can only be accomplished by the development of a high degree of co-operation, the cultivation of the spirit of "One for all and all for one."

The new note in business and industry is that which recognizes the fact that to profit at the expense of another is to sap the very foundations of society, whereas co-operation never fails to benefit the giver and the receiver in equal measure.

It is not enough that we co-operate in making a success of our own business, we should also co-operate to further civic interests in our community and lend ourselves unsparingly to public service.

"He profits most who serves best." Community riches are counted in the coin of service. Enrich your community and you enrich the world. The man who makes no contribution to community good will is in no position to complain if he is made to suffer because of ill will.

Self interest in national history means stagnation, extravagance and corruption and final collapse. The same doctrine holds good in individual life. To preserve self, thought and interest must be projected outside of self. Nor will it answer to simply talk about good will and public service. No one is fed if farm experts simply *talk* about growing wheat.

Public service comes into being automatically in times of stress. Start an epidemic, let loose a flood, launch a war or burn up part of a town, and everyone suddenly finds out that all the people they never knew and never cared to know are really neighbors; folks with homes and hearts and families and with souls that breathe and burn with charity and kindliness, folks who can weep with you, sacrifice with you, stand back to back with you and fight to the death.

Place a girl you never knew and never heard of on the top floor of a burning building for just five minutes and a city will hold its breath, firemen will risk life and limb, men will cry out in the agony of suspense and solicitude for her safety and women will weep and faint. But subject that girl to the slowly vitiating and deadening influence of cramped and unsanitary working conditions, long hours and insufficient pay, and the loneliness and despair of social neglect, and who will stretch out a helping hand?

The records of telephone companies are filled with instances of supreme and noble heroism, and it is well that this is so, but public service does not consist essentially in great or heroic acts, but in the quiet, normal relations of every day life. Every telephone man should be a specialist in the development and application of this science of service. There is no ritual for public service, just as there is no ritual for friendship. The technique of neither is capable of analysis or of being set forth in cold scientific formula. But service is a fact, just as friendship is a fact, and most men and women have a talent for both, latent though it may be.

To the telephone companies of Oklahoma I wish to say, support your State Utilities Association.

In our modern life, no great results are accomplished without group action. We have organizations for every conceivable purpose, wheels within wheels, up to the great and invincible union of states.

United effort built the pyramids of Egypt, erected the glorious temple of Solomon, enclosed in walls of adamant the Chinese Empire, opened a highway through the watery wastes of the Atlantic, leveled the forests of the New World, and reared in their stead a mighty nation.

An ancient Roman father who was about to divide his estate among his sons had them bring to him an armful of fagots. He directed the eldest son to break several of them, which was done with ease. "Now bind the faggots in a bundle," said the father, and attempt to break them. The boy did so, but the united fagots resisted his utmost strength. By this object lesson the sire taught the youth the virtue of presenting a united front to the difficulties and emergencies of daily life.

That principle is the animating and directing spirit of your organization. You have banded yourself together in order that each individual may lend to the entire group the elements of strength and talent which he possesses, and may in turn receive the help, inspiration and protection of the whole organization.

In no other business is organization, co-operation and harmony more essential than in the telephone business.

Union and harmony are taught us by one of the humblest of God's creatures, the busy workers of the hive, who build their cells of wax with a precision unequalled by the human workman, and store away their winter supply of food with unremitting diligence.

Members of this association, the degree of harmony and co-operation with which you face the work and problems of your industry will be the measure of our success. You are bound together for a common purpose, mutual advancement and mutual benefit. As the spokes of a wheel become nearer to each other as they approach the hub, the source of motion, so may you find in your union the key to a broader vision and greater power.

Phone Company Equipment Will Be Rehabilitated

The Ohio Telephone Service Company, operating the Greenville Exchange and other exchanges in Darke county, consisting of Arcanum, Ansonia, Versailles, Bradford, Gettysburg, Rossburg, New Madison, and probably Hollansburg and other points in Darke county; also at Sidney, Ohio, and other points in Shelby county, desires to make the following statement of facts, believing it is due to the patrons and the public:

"This company was not taken over for the purpose of exploiting it. We wanted the property to connect up with large holdings we have in the Southwestern part of Ohio and Northwestern Indiana, so that better service can and will be rendered the patrons and public. We do not intend to oppress the patrons or the public. We only want, and should have a fair return upon the face value of our property.

"This contract of purchase had been made before the date of the hearing on the rate raise, but the company was not formally taken over until Monday, the 2nd day of July, 1928. It was at our suggestion that the rate case was dismissed, for the reason that we thought the service should be improved first."

The officers of the new company are as follows:

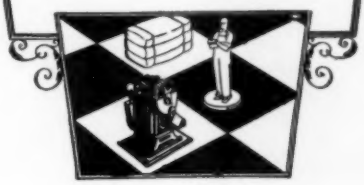
George W. Mannix, Jr., president and general manager; Pierre F. Goodrich, son of ex-Governor James P. Goodrich, of Indiana, and extensively interested in Public Utilities in Ohio and Indiana, vice-president and treasurer; R. W. Frost, Eminent Telephone Engineer, secretary; Karl Schmermund, assistant-secretary and auditor.

Savannah.—American Oil Company to erect new filling station at Jones and Whitaker streets.

Waycross.—Southern Bell Telephone Company completes two major extensions here.

Here, *Gentlemen of the Committee,* is the answer of one industry

No. 2 of a series inspired by the report of the Secretary of Commerce's Committee On Elimination of Waste.



PLANNING MOVES FIVE YEARS AHEAD

SEASONAL production with all its economic disturbance persists as an evil in many American industries. But in telephone making it has well-nigh disappeared.

Western Electric knows substantially what it must produce five years hence because of its close relation to the Bell System. Telephone engineers, skilled in gauging population trends in the growth of telephone service, establish the requirements to which Western Electric directs existing production facilities and provides for additional facilities when and where needed.

What follows is a production curve relatively free of peaks and valleys. Inventories are kept at a minimum, machinery is busy, employment is stabilized, plant investment is accurately related to production needs, wages have progressively risen relative to the cost of living, while prices have been substantially reduced.

Thus does Western Electric, by balancing production with demand, eliminate waste in the great industry of telephone making.

Western Electric

Purchasers... Manufacturers... Distributors

SINCE 1882 FOR THE BELL SYSTEM

A Unique Switchboard Installation

By H. N. FARIS,
Technical Engineer, Central Kansas Telephone Company

In recent years there has been much talk relative to improved equipment enabling operators to handle larger loads and at the same time, give better service in common battery exchanges. It should not be overlooked that similar progress is being made by the more progressive manufacturers and operating companies in magneto exchanges.

An installation that is the last word in magneto exchanges was just completed at Wakeeney, Kans., by the Central Kansas Telephone Company. Open house was held for some six hundred and fifty Trego County people and telephone men from surrounding towns. The many new and unique features of the switchboard were described.

For instance, the operator no longer has to constantly observe the entire face of the switchboard to avoid missing calls. With the new system a white "Pilot Lamp" lights directly in front of the operator whenever a call comes in and remains lighted until it is answered. Should two calls come in together, causing a single buzz, the operator cannot overlook the second call because the pilot lamp will not go out until it has been answered.

The pilot lamp also serves as a constant check on the night alarm system, for so long as the pilot lamps operate properly in the day time the night alarm equipment can be depended on at night.

An up-to-date ringing system does away with the noise and confusion of buzzers and substitutes an indicator lamp to show when lines being called are in trouble and how severely.

J. W. Herdt, General Manager, Central Kansas Telephone Co., Wa-Keeney, Kans.

Chest type, loud speaking transmitters have been substituted for the old swinging type. The new transmitters follow every movement of the operator and keep the mouthpiece close to her lips so she can speak quietly and not interfere with other operators. New and extra sensitive receivers make it easier for the operators to get called numbers correctly.

Ringing keys on the new equipment have been entirely separated from the operators talking key to reduce the possibility of ringing a patron in the ear.

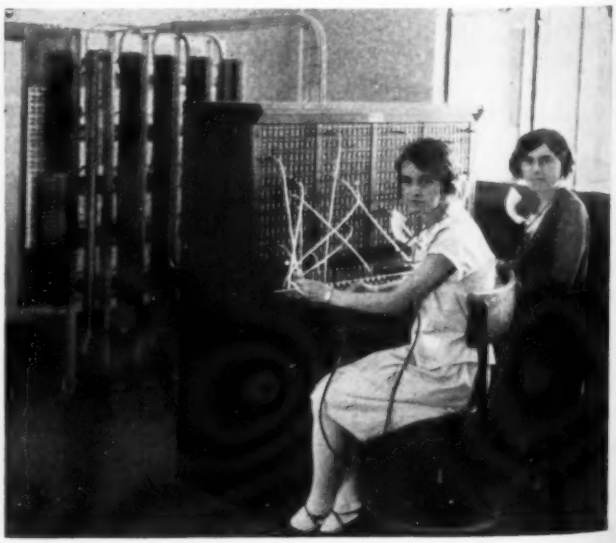
The cord circuits, which really constitute the switching equipment, are of the latest improved type, and enable each talking party to ring off separately, and without "ringing through" and disturbing the bell of the connected party. This is accomplished by using the "inductive coupling" system instead of tying the lines together either direct or through condensers.

If one of the parties desires to "recall" the operator, instead of ringing off, it is only necessary to give one-half turn instead of the usual three turns.

In addition to the supervisory lamps associated with each cord pair, the operator also has a large red pilot lamp which remains lighted so long as any disconnect or recall signals remain uncared for. With proper attention on the part of patrons to always "ring off" and recall correctly, the operation of the new switchboard becomes principally a matter of "keeping the lights out."

Magneto switchboards in the past were built to limit the line circuit space to 150 or 160 lines per position. With the modern improvements of line and supervisory pilots and the lamp signal key-shelf supervision, this limit has long been ridiculously low for local positions serving individual lines. The more progres-

New exchange building of the Central Kansas Telephone Co., Wakeeney, Kansas



New two-position Kellogg switchboard recently installed in the office of the Central Kansas Telephone Co., Wakeeney, Kans.

Four for Two is the HAYES Rate for You!

$4.00 FOR TWO No Higher

HAYES HOTEL NORTH

420 Diversey Parkway
at Lincoln Park
CHICAGO

OPPOSITE the famous Lincoln Park where you may enjoy golf, bathing, boating, tennis, riding and many other sports--only 12 minutes to "loop" --all north bound busses pass our door.

Every room with bath

Rates
Single —$2.50 to $3.00
Double—$3.50 to $4.00
NO HIGHER

Attractive Weekly Rates

Also operating
HAYES HOTEL SOUTH
64th at University Ave.

John Hayes Frank Hayes

Write for booklet

The right flame for any installation work

Prest-O-Lite equipment offers a wide variety of flames. From a wide brush flame for general soldering and heating to a small sharply defined flame for making delicate connections.

There is a Prest-O-Lite Torch for every brazing, soldering or heating purpose. Telephone companies everywhere use Prest-O-Lite equipment for lineman's work and in the shop as well. Most of the larger utilities have standardized on Prest-O-Lite.

Ask the Prest-O-Lite distributor about this equipment or write us direct for complete information.

THE PREST-O-LITE COMPANY, INC.
Unit of Union Carbide & Carbon Corporation
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Prest-O-Lite GAS

sive companies have long insisted on 200 lines per position, through the use of ten per strip equipment. They also desired facilities whereby the rural lines could be distributed in front of the local positions, thereby more nearly completing an operator's load.

The switchboard installed at Wakeeney was designed by the Kellogg Company to meet the present demand for this improved service. It is of the two position low type arranged with four panels of ten per strip equipment to afford 400 local lines, with an 11th row for 40 toll, rural and miscellaneous lines. It can be appreciated that this system has all the advantages of the low type switchboard with the regular decimal numbering of common battery practice, while the 11th row for toll, rural and miscellaneous lines corresponds to the space below the multiple shelf in common battery equipment.

In the future should the Central Kansas Telephone Company find it necessary to add a 3rd or 4th position, it can be furnished in the single or double position section with standard jack and relay ending transfers. The jack end of such transfers is properly located and designated in the miscellaneous space, while the plug grouping, above referred to, makes it unnecessary to place the transfer plugs in a third row as per former practice.

With one position devoted to toll and with 100 line "overhang" allowed in the toll position from two local and rural positions, a 550 line equipment with a possible "forced capacity" of 660 lines is afforded in a low cabinet and involving practically no transfers except those used for toll trunk purposes.

In like manner, a 4 position, 880 line low down equipment extends the possibility of this high-class magneto switchboard well into the realm of common battery. If the company desires to continue this large plant as magneto until the proper time for rebuilding and converting to common battery they can do so with this high class magneto equipment. This equipment will afford better service and operating economies. It will transfer into another magneto plant or find a ready sale, if offered to neighboring exchanges using old style magneto equipment.

The new equipment is located on the ground floor of the building recently purchased by the telephone company. The remodeling of this building for telephone purposes was planned by General Superintendent J. E. Flint and Mr. Ralph Van Trine of Abilene. The work on the building was done by a local force under the supervision of J. H. Fargo, building superintendent for the company.

Recabling work was done by W. C. Wilking, construction superintendent, and the cable splicing by W. H. Long, who also installed the switchboard under the supervision of Mr. H. N. Faris, technical engineer.

The local plant is ably managed by John Herdt of Wakeeney.

Kellogg's New General Catalog Ready for Mail

Many new and interesting items are shown in the Kellogg Switchboard and Supply Company's new General Catalog No. 8. In reading it through from cover to cover many ways of saving money and increasing revenue are to be found.

The entire catalog has been arranged for quick reference. There is a "Contents Page" in the front to enable one to promptly locate the different sections. Each main division also has a contents page showing where each type of equipment is to be found.

All types of switchboards including wire chief's testing equipment are shown

first. These are followed by telephones, intercommunicating systems, complete power equipment and all apparatus listed alphabetically.

Next is an entire new piece parts section showing repair parts for all of their standard apparatus. This is followed by a complete listing of line supply and construction material. On pages 247 to 250, inclusive, the steady growth of the Kellogg Company is illustrated.

Something New for Solder Users

The latest Kester product of the Chicago Solder Company is a self-fluxing wire solder, containing a soldering paste flux, and will be welcomed by solder users the country over, who have for years been working with separate soldering paste and ordinary solder.

Kester Paste Core Solder is now being produced in 18-inch lengths in hollow wire form of virgin tin and lead. This hollow wire is filled with a soldering paste that is pocketed in such a manner as to allow just the right amount to be released as heat is applied to the solder.

As a combination of the two old products it is much more convenient to handle and much more simple to apply. This simplicity makes it possible for the user to perform a clean and finished job.

Needless to say there is quite a saving in the cost of this new combination over that of the old separate products. One

may buy Kester Paste Core Solder by the stick, the pound or by the carton, which contains approximately one hundred and fifty of the 18-inch lengths.

This new product is in no sense introduced to supplant either the Kester Acid Core Solder or the Kester Rosin Core Solder. Each of these has its very

definite use in its particular field. It has been introduced to meet a long-felt demand from users of the common solder and paste method, for an up-to-date, convenient product as applicable to their field as the acid-core and rosin-core are to theirs.

The Chicago Solder Company has long been aware of this demand and, after painstaking efforts on the part of its experimental divisions has placed this Kester Paste Core Solder on the market.

Increased Use of Creosoted Pine Poles

Pressure creosoted southern pine poles again showed a greatly increased demand in 1927, according to figures just released by the U. S. Forest Service, prepared in co-operation with the American Wood-Preservers' Association. Pine poles treated in 1927 almost equaled the total number of poles of all other species treated in that year. Distributors and users of these poles claim this big demand is due to their great strength and their longevity when given a full length pressure treatment with coal-tar creosote. The past ten years has seen an increase of almost 2,500 per cent in the number of southern pine poles treated. The almost steady yearly increase during that time is shown by the following figures:

1918	67,541
1919	156,346
1920	167,289
1921	224,777
1922	291,991
1923	451,852
1924	899,201
1925	780,248
1926	925,929
1927	1,738,839

AMERICAN CROSSARM & CONDUIT CO.
14 Mills Main Office—Chicago, Ill. 36 Warehouses
Manufacturers and Distributors
CROSSARMS — FIR — Creosoted — Yellow Pine
Creosoted Wood Conduit
Pin and Brackets

Super-Service on rush orders!

If you are in a hurry your order can be loaded and on the way the same day we receive it.
Quality poles since 1882 assures you of guaranteed stock and satisfactory dealings. Let us quote you prices.
Northern and Western Cedar
With or without butt treatment
NAUGLE POLE & TIE COMPANY
59 East Madison Street, Chicago
Branches: New York, Columbus, Kansas City, Spokane Vancouver, Boston Yards: *Minneapolis, *Pinconning, Mich.; *Spokane, *Sand Point, Ida.; Vancouver, B. C. *Butt-treatment plants and Pentrex incising machines.

Naugle Poles

Bell Cedar Poles
Piling & Ties
Western Red - Northern White
Creosote Butt Treating—Any Specification
Guaranteed N. E. L. A., W. R. C. A., N. W. C. A. Grades
Treating Plants and Concentrating Yards
Minnesota Transfer, Minn., Newport, Wash.
Other Concentrating Yards at British Columbia Points
There Are No Better Poles Than Those Produced by
BELL LUMBER COMPANY
Security Building Minneapolis, Minn.
Long Distance Phone Atlantic 2304

Cedar Poles
Northern White Western Red
Plain or Treated Butts
Prompt Shipment from Minneapolis Yard.
T. M. Partridge Lumber Co.
Minneapolis, Minn.

HUBBARD
GUY CLAMPS
X ARM BRACES
PINS
BOLTS
LAG SCREWS
WASHERS
GUY HOOKS
ANCHORS
GROUND RODS
TRANSPOSITION BRACKETS
HOUSE BRACKETS
DATING NAILS
GUY WIRE PROTECTORS
WRITE FOR COMPLETE CATALOG
HUBBARD AND COMPANY
PITTSBURGH
OAKLAND
CHICAGO

USE CHANCE ANCHORS
MORE PATENT ANCHORS
CHANCE MAKE BETTER POLE LINES
A Type and Size To Meet Every Need
Specify CHANCE ANCHORS Your Jobber Will Supply you
CHANCE CO.
CENTRALIA, MO.

INSURE YOUR OVERHEAD LINES
BY SPECIFYING
NORTHERN or WESTERN
CEDAR POLES
PLAIN or BUTT-TREATED
FROM
MacGillis & Gibbs Co.
120 E. Wisconsin Avenue,
Milwaukee, Wisconsin

REPUBLIC POLES
Northern and Western Cedar
Butt-Treating
REPUBLIC CEDAR CO., Marinette, Wisconsin

Single Interlocking and Multiple Crosoted Wood Conduit
ZINC CHLORIDE TREATED LUMBER
W. C. MEREDITH CO. Atlanta, Ga.

Design of Small Central Office Buildings

By B. C. BURDEN,
Lincoln Telephone & Telegraph Co., Lincoln, Nebr.

The main features to be considered in designing a central office building for the smaller exchanges, can be divided into the following heads:

1—Location.
2—Exterior architectural style.
3—Floor space.
4—Constructional details.

Obviously in the laying out of a new building, the selection of the location should precede the building design, as the location may materially influence the design. In the case of a standard office design then, of course, the building site must fit the building.

The most desirable site for either the small magneto or common battery office is one as close to the business district as possible, yet so located with respect to adjacent buildings that it can have a properly landscaped setting. The location with respect to the business district should be in the direction of the better residental section if possible. A location in the business section proper (except in the case of larger offices) is highly undesirable because of noise and dirt, as well as the additional fire hazard.

Small exchange buildings are of two distinctly different classes and are known as:

1—Residence office type.
2—Straight office type.

The residence-office type is arranged to house both equipment and operating personnel. It combines the function of a central office and a residence.

Virtually its only excuse for existence lies in the economy it offers in reduced operating costs.

Offices of this type are usually operated on a contract basis, i.e., the operating and sometimes the commercial duties are handled by a family, who live in the residence portion of the building, and who receive a flat monthly sum for their services.

This type of office is in general not as satisfactory as the straight office type although for the smaller towns, the economies it offers many times justifies its existence.

There are some fair-sized companies that are using residence-office type buildings, and renting the residence quarters to their manager or wire chief. Arrangements of this kind are based upon the assumption that it is desirable to have the wire chief or manager near the equipment for maintenance reasons. It is also thought that the revenue derived from rent more than carries the additional building investment represented by the residence quarters. This type of office is not favorably regarded however, except for the extremely small exchange handled on a contract basis.

Figure 1 shows the exterior view of a residence-office type structure that has been adopted by one large operating company for use on magneto offices of 50 to 400 lines. The construction is stucco on lath. Properly arranged on a well-located building site with a few judicious

Fig. 1—Residence type office building

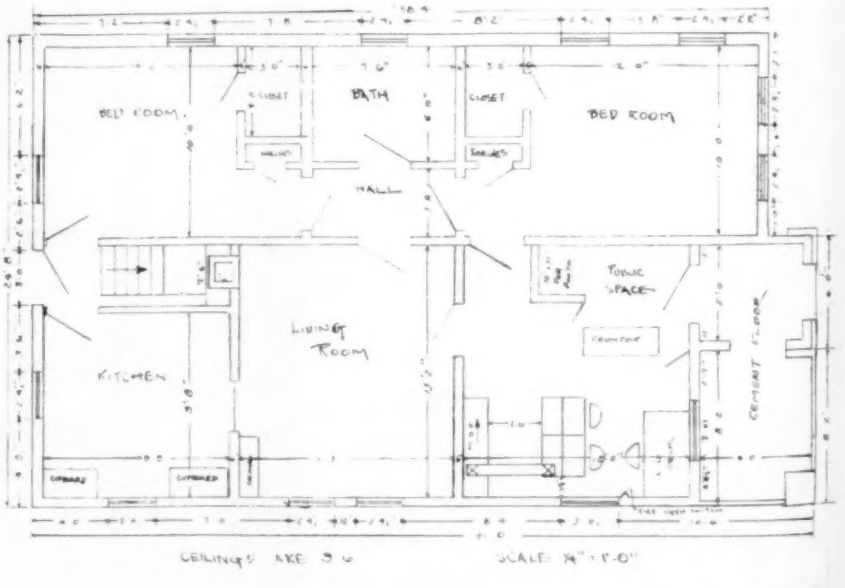

Fig. 2—Floor plan residence type office

plantings and a good lawn, this building leaves little to be desired in either appearance or utility.

Figure 2 indicates the floor plan of this building. It will be noted that ample room is available in the living quarters, yet the operating and equipment space is not crowded. The small amount of commercial work handled in offices of this size permits the switchboard being located in the commercial quarters. In fact in the majority of cases it is the operator that transacts most of the commercial business.

The need for a fire-proof structure is not as great in the case of the residence-office type of building as in the larger common battery straight office type. The reason for this lies in the reduced hazard because of the usual location in the residence section. Also replacement equipment can usually be obtained and installed quickly in the case of one and two-position magneto boards, whereas with the common battery equipment even in the smaller offices considerable time elapses from the time of a complete burn out and the restoration of even temporary service.

Figure 3 shows the exterior view of a common battery straight office type of building that was designed for offices of 500 to 1,000 lines. This office was designed with three outstanding factors in mind, namely: a fire-proof structure, economical in cost, and pleasing appearance. In general, it offers an attractive one-story building, that has that semi-business appearance that is more or less essential and yet it will be noticed that it has none of the squat, monotonous lines, usually inherent to one-story flat roofed structures. It apparently answers the description of the most building for the least money to fit given requirements. The canopy type glazed tile cornice is very effective in giving pleasing lines to this building. The cost of canopy tile cornice as against an all tile roof is about one-fourth of the cost of the latter. The tall and narrow windows also aid effectively in enhancing the exterior beauty of the building. The outside walls are of brick and stucco. Finish brick being laid up to the window sills. The main entrance portico, while of little practical value, adds to the pleasing appearance of the front portion of the buildings, and for this reason well justifies its added cost. The building is set back several feet from the sidewalk and when properly landscaped is a building that is a credit to the business it houses and to the town which it serves.

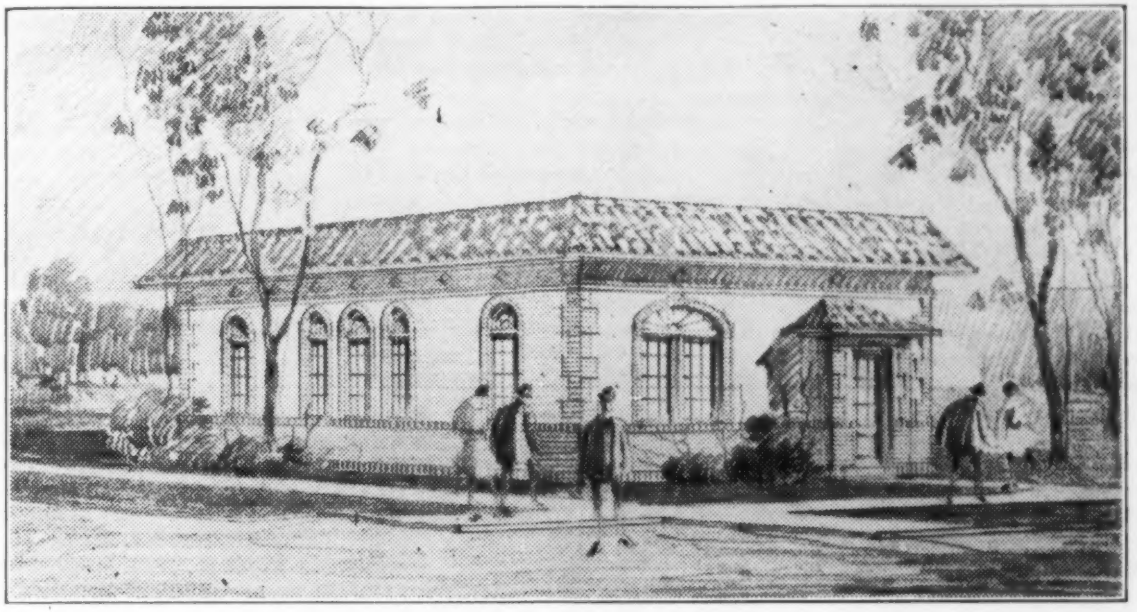

Fig. 3—Straight office type 500 to 1200 subscribers

The construction is practically fire-proof. This added construction cost was felt well justified in protecting equipment, the loss of which would not only affect the business of the telephone company but the business of those served by it. When a business house burns down, only one business is affected and the town goes on in a normal manner, but let a telephone office go up in smoke and the entire community's business is affected and to quote the papers, "the business of the town was paralyzed."

Figure 4 depicts the floor plan of this building. Upon entering the main entrance, one is impressed by the spacious and cheerful lobby. A wicket window in the door of the operating room enables the operators to transact business during the absence of the manager or at night. A feature which aside from its space saving feature has numerous other advantages is an arrangement whereby the rear of the switchboard opens directly into the terminal room. This is accomplished by placing the switchboard so that its back projects into the terminal room and then casing around the board so that the partition between the terminal and operating rooms is completely closed

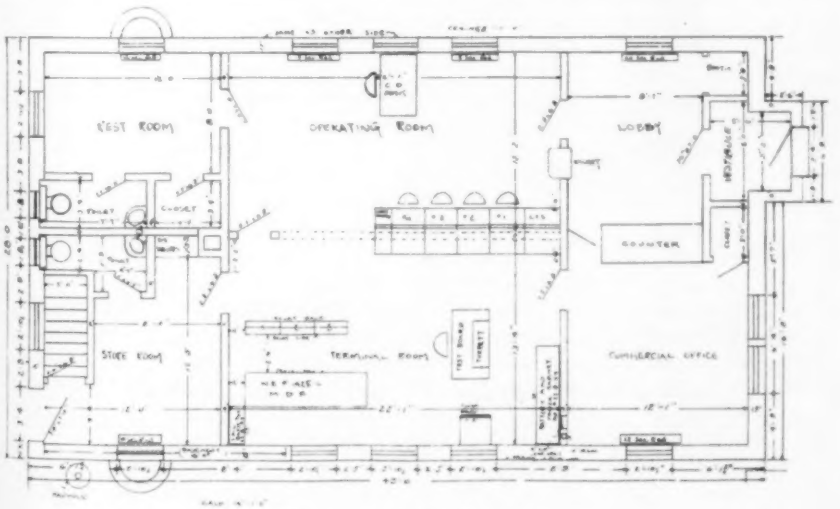

Fig. 4—Straight office type

in. False work is provided in this partition in the direction of switchboard growth, which is easily removed when new positions must be added.

A basement is provided only under the back 16 feet of the building. All floors are cement, covered with battleship linoleum, which has been found to be both durable and pleasing in appearance.

Figure 5 shows the floor plan of an office with similar exterior architectural lines but of smaller dimensions, and with no basement. The floor plan is self-explanatory. Note the hot water type heating unit located in the terminal room. This is one of the numerous "funiture style" heaters that have appeared on the market in the last few years. Finished in mahogany baked enamel it makes a neat and efficient heater, resembling a piece of furniture more than a heater. The use of this style heater does away with the necessity for a basement. The building arrangement does not permit the placing the switchboard integral with the partition between operating and terminal room, but this disadvantage is offset by the convenient access to the back of the switchboard by a door leading from the terminal room.

While in no way could the building I have described be classed as the "last word" in small central office buildings, yet, they represent one company's ideas, and several buildings of the styles and types described have been built and have proven very satisfactory.

Buildings cannot be constructed out of wishes or managers' reveries. Something more tangible in the way of an adequate rate structure is needed. Any well managed company who have not spent unwisely and whose capital investment is well protected by tangible physical property are justified in financing a suitable building to house the largest single portion of this investment. However, meager rates should not be saddled with this additional burden unless they are capable of sustaining it.

Additional Budget for New York Bell

J. S. McCulloh, president of the New York Telephone Company, announced July 27 that the board of directors, at their meeting held July 25, authorized the additional expenditure of $3,171,845 for new construction in various parts of the territory served by the company. This brings the total appropriations made since the first of the year to $42,116,096, of which $37,235,244 were set aside for enlargement of telephone plant in the Metropolitan area.

Items scheduled for the Manhattan area in this appropriation include the installation of additional switchboard and associated equipment at various central offices. The authorization for outside construction in this area includes the installation of trunk plant in connection with the opening of two new dial central offices in the East 56th Street telephone building.

In Brooklyn, the appropriation provides for additions to and improvements in the switchboard and trunking equipment of various central offices, together with underground and aerial plant additions.

In suburban Long Island the construction program includes additions to the outside plant in Jamaica and neighboring communities, and various additions and improvements in the Huntington, Babylon, Bayshore, Farmingdale and Northport central office districts.

At Haverstraw, which is included in the Bronx-Westchester area, a new machine-switching office is authorized. The appropriation also provides for additions to outside plant equipment in various parts of the Bronx and at numerous points in Westchester County, including New Rochelle, Pelham, White Plains, Pleasantville and Armonk.

Four New "Caterpillar" Books

A set of four books covering different phases of industry have just been published by the Caterpillar Tractor Co., San Leandro, Calif., and Peoria, Illl. The titles are "'Caterpillar' Power for Public Utilities"; "'Caterpillar' Power for Factories"; "'Caterpillar' Power for Mines & Quarries"; "'Caterpillar' Power for Railroads, Warehouses and Docks." They are completely illustrated with action photographs gathered from "Caterpillar" jobs throughout the world. Write to the San Leandro, Calif., headquarters or call at your local dealer in "Caterpillars" for free copies.

"'Caterpillar' Power for Public Utilities" has 40 pages, divided into sections —Telephones, Gas, Water, Light and Power. Hauling over mountainous roads, stringing cables and salvaging old wires are some telephone jobs described. Filling ditches, laying pipe line, pulling pipe sections into place, excavating for gas plant, moving camp, and hauling are seen in the gas section. "Bigger than the weather," the old "Caterpillar" slogan, hits the reader in the striking pictures of mud, sand, ice and snow work required in public utility work.

The laying of 240 feet of electric cables under brick paving in six minutes' time is pictured in the section on light. This involves use of a sub-soiler. Moving pile drivers for the Southern California Edison Co., pulling cement forms for the Commonwealth Edison Co. in Chicago, clearing snow from Idaho roads for building transmission lines for the Washington Water Power Co. give an idea of the kind of work as well as the size of concerns using "Caterpillars." Scenes in Japan and Brazil where power and water developments are wrested from raw frontiers shows how other sections of the world are following the latest developments in the United States construction methods.

Pictures from the Studebaker proving grounds, motion picture caravans on location on snow-covered mountains, steel factories, bulldozing in construction of a General Motors plant, pulling stumps to make Hercules gun-powder, leveling for railroad side tracks, lifting poles with cross arms for the Pennsylvania Edison Co.; hauling over mountains, deserts and streams regardless of weather; moving 7-ton sewer pipe connections, skidding big boxed export packages into cars from factory siding; glass factories, spool factories, founderies, brick plants, sugar factories, copper and brass factories; at drawbar, belt, power take off or winch, the "Caterpillar" does the world's hard jobs in scenes caught from the busy workaday world. The factory book tells the story.

Changes in Wagner Organization

The Wagner Electric Corporation announces that Alex L. Miltenberger, heretofore Pacific Coast manager with headquarters in San Francisco has been transferred to St. Louis as branch manager of the St. Louis office.

Immediately upon graduating from Columbia University in 1909 as an electrical engineer, Mr. Miltenberger entered the employ of Wagner Electric Corporation and took the regular student engineering course. In 1912 he was employed as a salesman in the St. Louis district office. In 1920 he was promoted to western supervisor with headquarters in San Francisco, from which position he has now been transferred to branch manager of the St. Louis territory.

The Wagner Electric Corporation announces that Mr. Fred Johnson heretofore in charge of the Wagner Electric St. Louis sales office, is now manager of the Los Angeles branch office. This transfer brings to a close twenty-one years of service as district manager of the St. Louis territory.

Mr. Johnson has been connected with electrical sales activities ever since 1898, at which time he started to sell incandescent lamps for the Martin J. Insull Company of Chicago. In 1899 his employer became connected with the General Incandescent Arc Light Company, New York City, taking Mr. Johnson with him. In June, 1900, Mr. Johnson was made manager of the G. I. Company's Chicago office, soon thereafter joining the Wagner Electric Corporation, to take over the St. Louis district sales office, from which he has now been transferred to Los Angeles office.

Pardeeville Telephone Company to Be Converted to Automatic

The Pardeeville (Wis.) Telephone company has been sold to F. H. Runkel, of Portage, manager of the Portage Telephone company. It is stated that a new exchange building will be constructed and that the exchange will ve converted to automatic, cable laid in the entire business district and other improvements contemplated.

Missourian Buys Oklahoma Exchange

E. Noe of Richland, Mo., recently bought the Welch Telephone company of Welch, Oklahoma. Noe is present owner of the Richland exchange, having operated it for the past twenty-five years.

Flat Rock Exchange Has New Feature

A new and complete switchboard has been purchased and will be installed in the near future at the Flat Rock telephone exchange, it was announced today. The board is the most up to the minute inventions for insuring the best service obtainable and has been procured at a considerable cost. The installation of this new switchboard will be a long step in making the telephone service the best in the county.

Phone Co. Issues $100,000 Stock

Madison, Wis.—Authorization of a $100,000 stock issue by the Community Telephone Co. to finance the purchase of the Prospect Telephone exchange, the Darien Telephone Co., the Colfax Telephone Co. and the Blair Telephone exchange was announced by the Wisconsin railroad commission.

Texas Association to Hold District Meeting

The Texas Independent Telephone Association has announced a district meeting to be held August 23 and 24 at Corpus Christi, Texas.

WANTED—Large Class "A" Telephone Company wants Assistant Commercial Superintendent. Applicant should send answer care of TELEPHONE ENGINEER, stating age, education, experience, references and salary expected.

WANTED—Experienced Plant Chief by growing Telephone Company now operating 35,000 stations. Must have thorough knowledge of Magneto, Common Battery and Strowger Automatic Systems. Write, giving full information about yourself and salary expected.

RECONSTRUCTED EQUIPMENT

Automatic Elec. Co. No. 60707 late type Wood Hotel sets with Ind. coil ckt., complete with Trans., Rec. and Dials, @ $4.75

Auto. Elec. Co. No. 60825 latest type Steel Hotel sets with Ind. Coil, Booster ckt., complete with dials (enclosed gong type) @ 7.25

Auto. Elec. late type Desk Sets, complete with dials and Ind. Coil ckt., black finish wood signal sets with either straight line or harmonic ringers, @ 6.50

Auto. Elec. Co. latest type Desk Sets, complete with dials, Trans., Rec. and cords @ $5.00; with enclosed gong type steel signal sets @..... 7.50

Automatic Elec. Permanent magnet type Receivers complete with cord @.... 1.10

Auto. Elec. Direct Current Receivers, complete with cords @..... .70

Kellogg No. 97 or No. 118 C. B. Desk Sets, complete with No. 75 or No. 259 Steel signal sets @..... 7.25

Western Elec. No. 20 Desk Set, complete with 3-bar 1000 or 1600 ohm exposed post signal set @..... 9.50

Kellogg No. 2696 type 4-bar 1000 or 1600 ohm Bdg. compacts @ 8.50

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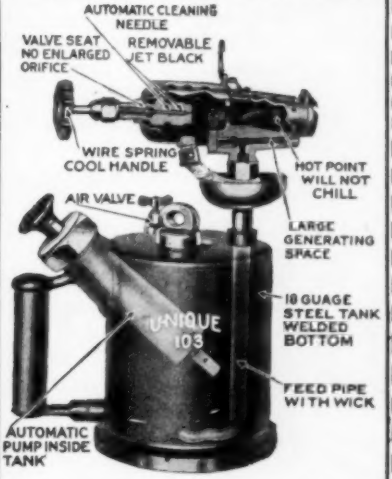

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Harding and Kemp Sell Interests in Holtzer-Cabot Electric Company

Edwin R. Harding, president, and William S. Kemp, treasurer, and Thomas W. Ness, former signal sales manager of the Holtzer-Cabot Electric Company, Boston, Mass., large minority stockholders in the company, have sold their holdings. Mr. Harding and Mr. Kemp have tendered their resignations, to be effective at an early date. Mr. Ness retired some months ago.

Mr. Harding has been connected with the company nearly 30 years. He is a

Edwin R. Harding, retiring president of Holtzer-Cabot Electric Co.

native of Maine and a graduate of Bowdoin College of the class of 1885, receiving a degree of A. B. upon graduation, and later having conferred upon him the honorary degree of A. M. by the same college.

After graduation, he taught for a few years, being principal of Patten Academy, Patten, Me., and principal of Winthrop High School, Winthrop, Mass. He then went to Chicago and entered the employ of the Edison General Electric Company. While with Edison, he was the first to develop an electric variable speed foot control rheostat and motor used for dental drilling purposes, the principle of which is so commonly used now in dental offices.

In 1898 he established the Western office of the Holtzer-Cabot Electric Company with headquarters in Chicago. He gradually developed a Western business until 12 of the Midwestern states were added to, and controlled by, the Chicago office. He did a very large business for the corporation. In 1908 the company, by the suggestion of, and under the supervision of, Mr. Harding, built a fireproof reinforced concrete building at 6161 South State Street, Chicago, Ill., to be used as an office, warehouse and small manufacturing shop in order to give better and quicker service to the Western customers.

He had much to do with the pioneer development of the motor business. He induced his company to develop a line of multipolar direct current motors, and his company was foremost in the field with this type.

Mr. Harding was among the first to push the development of split phase fractional horsepower alternating current motors (manufactured under the Tesla patents at that time) so that they would have sufficient starting and pull-through torque to make them commercially practical for special household and office application work. These were the days when the old Edison bi-polar motor was in vogue and the Stanley alternating current power motor had to be started by pulling the belt.

He has been very active in the independent telephone manufacturing field in developing and manufacturing telephone electric power plant machinery. The noiseless type of generator for charging telephone storage batteries and telephone signal apparatus of all kinds has been greatly improved under his supervision.

Mr. Harding for many years was a director and first vice-president of the company, in charge of the Western states with headquarters at Chicago. In 1924 he was called East and made president.

His policies have been ones looking to efficiency in all departments:

Cutting out extravagant habits induced by the war period.

Cutting down top-heavy overheads in both personnel and system.

A determined drive to lower the cost of product by:

Time studies of set-ups and operations as a basis of study for speeding up production.

The invention and development of special machines to perform specified operations.

The co-ordination and sequence of operations in the transposition systems of production.

Making scheduling systems more flexible so that they be fitted better to the nature of the manufacturing to be done.

A constant drive at better mechanical engineering, better design, and better tool study in order that the engineering designs of product will be the better suited to efficient factory production methods.

During his presidency the company has made much progress in the reduction of cost of product.

* * *

Mr. Kemp entered the employ of the company December 1, 1904, and a few months later became treasurer and director, which positions he has held until he resigned.

Previous to associating himself with the company, he was cashier of the Brookline National Bank of Brookline, Mass., now the Brookline Trust Company. While with that bank he was the originator of what was commonly called the "Envelope System," by which each depositor's account was balanced every month. Prior to the adoption of that system the accounts were only balanced when the depositor's bank book was presented for that purpose. The system was extensively adopted and continued in use until the mechanical bookkeeping machine made the use of the present bank statement possible.

As treasurer of the Holtzer-Cabot Electric Company, he handled all credits

William S. Kemp, retiring treasurer of Holtzer-Cabot Electric Co.

and financial matters and had supervision of all the accounting.

While he has a large acquaintance in financial circles, he is best known as an industrial cost accountant.

During the season of 1922-23 he gave a series of talks before the Boston Chapter of the National Association of Cost Accountants. These talks created so much interest in the accounting field that, with his permission, the National Association of Cost Accountants of New York published the same in book form under the title of "Departmental and Standard Costs." This book has had a wide distribution. The following year, he was elected president of that association.

In 1926, as a representative of the association, he delivered a paper before the International Accountants Congress at Amsterdam, Holland.

For a number of years he has been a member of the Standing Committee on "Standard Accounting and Cost System for the Electrical Manufacturing Industry."

From the day he became treasurer of the Holtzer-Cabot Electric Company up to the date of his resignation, a period of nearly 25 years, the company never failed to discount a bill subject to a cash discount and to promptly pay all other bills. He leaves the company with no floating indebtedness and in a strong financial condition.

Two years ago, with his family, he spent a year in travel abroad. He expects to spend the coming year touring this country.

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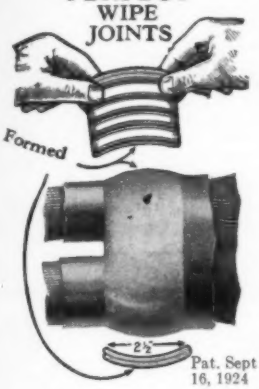

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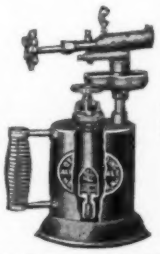

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Utility Order Is Voided by Court

An order of the Indiana public service commission that the costs of appraisals, other than those ordered by the commission itself, cannot be considered as operating expenses when a utility company is asking a rate readjustment, has been declared unreasonable and null and void by Judge Sol A. Wood, of the Allen circuit court, in an appeal from the order taken by the Indiana Service corporation and the Home Telephone and Telegraph company, both of Fort Wayne, Ind.

The ruling of the court will make the order of no effect as regards the two companies which appealed, unless an appeal from the ruling is carried to the appellate court by the public service commission and won. Companies not appealing to the circuit court which has jurisdiction over the place in which they are located are still governed by the commission's ruling, Judge Wood said.

The two Fort Wayne companies won their appeal in the local court without any contest, due to the fact that no representative of the public service commission appeared to defend it. The ruling was virtually a judgment by default.

Judge Wood held that unless all utility companies in the state were parties to some action before the board involving a question being litigated, the public service commission could not make a blanket order binding them.

The resolution of the commission was passed March 3, 1928, after a telephone company of small capital had included a sum of $10,000 spent for appraisals ordered by itself, in a report of operating expenses made at a rate hearing.

"The commission's order no doubt was justified as to this one company," Judge Wood said. "But it was unreasonable to make a sweeping ruling binding all utilities in the state because this one particular firm had spent an excessive sum to have its property appraised."

The full text of the order and resolution made by the public service commission on March 23, is as follows:

"Be it resolved by the public service commission of Indiana that, authority of the Acts of 1927, chapter 145, page 445, of the general assembly of Indiana, from and after this date, no expense incurred by any utility for the establishment of a valuation for any purpose, other than the cost of an audit and appraisal by the auditing and engineering departments of said commission, as provided by chapter 60, Acts 1925, shall be allowed as costs chargeable to operating expense in any proceeding before the public service commission of Indiana; and when any such additional expense is incurred it shall be paid for from net income below the line by such utility."

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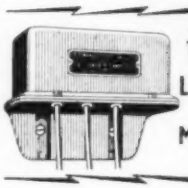
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"The Autobiography of a Black Cedar Pole"

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This little booklet of 24 pages, 3x4 inches, tells in a few words the many tests to which pine is put before it is permitted to be offered for sale. And it is so interestingly written that you will enjoy reading it; the information contained therein will be of lasting advantage to you in testing pole penetration when you want to make a test.

This booklet will be sent to anyone interested on request to the Texas Creosoting Company, Orange, Texas.

New Map Shows Oklahoma Phone Ownership Scattered

A new map in the offices of the Oklahoma Utilities Association, showing ownership and location of the telephone exchanges of the state, is arousing considerable interest in those who see it, on account of the wide diversity of ownership of telephone properties which it reveals. The map shows 566 exchanges in the state, 151 of which belong to the Southwestern Bell Company.

Independent telephone companies, so-called because not owned by the Bell interests, number 231 and serve 351 towns and cities. The Southwestern Bell serves 151 towns. The 566 exchanges in the state serve 285,000 subscribers.

New Treatise on Cedar Issued by MacGillis & Gibbs Co.

The MacGillis & Gibbs Company, Milwaukee, Wis., has issued one of the most complete catalogs ever issued by any manufacturer of cedar products. The booklet contains 48 pages and beautiful cover and on every page is special information regarding cedar and its uses, possibilities, preservatives, etc. In fact it is a complete treatise on cedar, and covers many phases of that very necessary timber.

Some of the subjects touched in this booklet are: Pole timber and its requirements; timber preservation and forest conservation; sapwood and heartwood, weathering and decay; preservatives; service tests; theory of the impregnation of cedar; MacGillis' penetration-process poles; newly developed perforating machine used by this firm; treatment and results; treating plant equipment; treated versus untreated poles; the economy of treated timber; handling and setting treated poles; strength of poles; comparative strength of western red cedar and creosoted southern yellow pine poles; methods of measuring poles, specifications, pole weights and number per car load, and many other subjects.

The cover is beautifully embossed and shows native cedar in its natural forest. Every telephone company should have one of these catalogs. Write the MacGillis & Gibbs Company, Milwaukee, Wis.

Folders That Tell the Story of Pole Preservation

J. W. Prettyman & Sons, Charleston, S. C., have just issued a series of folders showing the value of creosoted pine poles in general and of the Prettyman Preserved Poles of Southern Yellow Pine in particular. These folders are attractive, well worded and beautifully illustrated. Much information of value can be learned from a perusal of these folders, and they may be secured by writing J. F. Prettyman & Sons Wood Preserving Plant, Charleston, S. C.

Book Review

Probability and Its Engineering Uses, by Thornton C. Fry, Ph. D., D. VanNostrand Company, New York.

This is another of the series of books by members of the technical staff of the Bell Telephone Laboratories. The material was first prepared for one of the "Out-of-Hour Courses" of the laboratories and was later revised for use in a series of lectures delivered at the Massachusetts Institute of Technology. Like the other books of the Bell Telephone Laboratories series, it impresses the reader as a thoroughgoing and authoritative treatment of the subject.

Probability has important applications in telephony where there is a problem in every case where a group of sources of calls has access to a group of channels over which the calls may be transmitted, but the author has not limited himself to telephone problems. The treatment is broad enough to cover a variety of applications of the theory of probability to engineering and physical science.

The method of presentation is a combination of logical and mathematical reasoning. The style is clear and readable and to those who have the necessary background of mathematics the books will offer an interesting insight into the possibilities of application of the theory to various types of scientific and engineering work.

Ed. Glandon Buys Calhoun Phone System

The Calhoun Telephone Company has been sold by Henry Narup of Hardin, Ill., to Ed Glandon and others, and will be added to the properties of the Pike County Telephone Company with headquarters at Pittsfield, Ill. It is intimated that other properties in Calhoun county will be taken over by this firm. Announcement that material improvements in the recently assumed properties is contemplated immediately.

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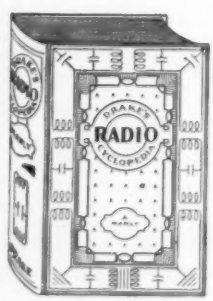

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